INTERNATIONAL MARITIME HEALTH ASSOCIATION WORKSHOP

BREST, FRANCE

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METABOLIC SYNDROME AMONG SEAFARERS

RAPPORTEUR : Jean Ariel Bronstein

Venue meeting place : Hôpital d'Instruction des Armées CLERMONT-TONNERRE - Brest

Local organizing committee in France :

• Dr Dominique Jégaden, President of SFMM, IMHA member, medical advisor for Ifremer, Maître de Conferences UBO. Coordinator of the workshop.
• Pr Jean-Dominique Dewitte, Professor of occupational medicine, director of the UBO University Diploma on Maritime Medicine, IMHA member.
• Pr Jean Ariel Bronstein, Professor of Naval Medicine (Service de Santé des Armées), IMHA member
• Dr Brice Loddé, UBO, IMHA member

International organizing committee:

• Objective 1: Research in Metabolic Diseases in seafarers: to review studies related to seafarers to evaluate its relevance in occupational maritime health.
o Report reference group : Dr M. Luisa Canals (ISM, URV, SEMM, IMHA, Spain), Dr. Maria M. Rodriguez (INEA, UCM, IMHA Latina, Venezuela)

• Objective 2: Prevention of Metabolic Diseases in seafarers. International Project. Progress report, orientations.
o Report reference group: Dr Olaf Jensen (SDU, IMHA, Denmark), Rob Verbist (Mediport, IMHA, Belgium)

• Objective 3: Repercussion of Metabolic Diseases in Seafarers fitness examination :
o Report Reference group: Dr Tim Carter (IMHA, UK), Dr Heikki Saarni (IMHA, Finland)

INTRODUCTION –

The worldwide epidemic of obesity has finally crossed the ocean, and affected the thousands of seamen engage in maritime commerce. Obesity could dramatically impact the manner in which a seaman is able to discharge his duties on the vessel.

According to the press release, the number of obese seamen on international vessels has increased substantially in recent years. Work at sea is extremely physical and strenuous work. Unfortunately, increasingly high caloric food and unhealthy eating habits have contributed to more cases of obesity among maritime workers. The International Maritime Medical Association stresses that obesity is a major concern. Obesity may cause serious health problems (*Batty GD et al. Obesity and overweight in relation to disease-specific mortality in men with and without existing coronary heart disease in London: The original Whitehall study. Heart 2005*), and at sea it may also be of importance to the safety of the seafarer himself as well as the safety of the ship. Proper documentation regarding this problem is sparse, but there is anecdotal data like the following example: During a vertical chute evacuation drill in 2002 on a ro-ro ferry, a fatal accident occurred and was investigated by the Marine Accident Investigation Branch (MAIB) (*Marine Accident Investigation Branch. Report on the investigation of a fatal accident during a vertical chute evacuation drill from the UK registered ro-ro ferry P&OSL Aquitaine in Dover Harbour on 9 October 2002*). The deceased person was a female, 53 years old, 1.68m height and weighed about 100 kg. (BMI = 35.4). The most likely cause of death was reported to be positional asphyxia, but obesity may be a likely contributing cause, even though it is not mentioned in the investigation report.

Obesity, particularly abdominal obesity, is associated with resistance to the effects of insulin on peripheral glucose and fatty acid utilization, often leading to type 2 diabetes mellitus. Insulin resistance, the associated hyperinsulinemia and hyperglycemia, and adipocyte cytokines (adipokines) may also lead to vascular endothelial dysfunction, an abnormal lipid profile, hypertension, and vascular inflammation, all of which promote the development of atherosclerotic cardiovascular disease (CVD) (*Reaven, GM. Diabetes 1988; 37:1595.- DeFronzo, RA et al. Diabetes Care 1991; 14:173. - Lindsay H et al. Curr Diab Rep 2004; 4:63. - Koh KK et al. J Am Coll Cardiol 2005; 46:1978.*). A similar profile can be seen in individuals with abdominal obesity who do not have an excess of total body weight (*Richelsen, B, et al. Int J Obes Relat Metab Disord 1995; 19:169. - Ruderman, N, et al. Diabetes 1998; 47:699. - Conus, F, et al. J Clin Endocrinol Metab 2004; 89:5013. - St-Onge, MP et al. Diabetes Care 2004; 27:2222*).

The co-occurrence of metabolic risk factors for both type 2 diabetes and CVD (abdominal obesity, hyperglycemia, dyslipidemia, and hypertension) suggested the existence of a "metabolic syndrome". Genetic predisposition, lack of exercise, and body fat distribution all affect the likelihood that a given obese subject will become overtly diabetic or develop CVD.

DEFINITION

There are several definitions for the metabolic syndrome, leading to some difficulty in comparing data from studies using different criteria (table 1). The National Cholesterol Education Program (NCEP/ATP III) and International Diabetes Federation (IDF) definitions are the most widely used.

2001 National Cholesterol Education Program/ATP III – Guidelines developed by the 2001 National Cholesterol Education Program (Adult Treatment Panel [ATP] III) focused explicitly on the risk of cardiovascular disease, and did not require evidence of insulin or glucose abnormalities, although abnormal glycemia is one of the criteria.

Current ATP III criteria define the metabolic syndrome as the presence of any three of the following five traits:

- Abdominal obesity, defined as a waist circumference in men >102 cm (40 in) and in women >88 cm (35 in)
- Serum triglycerides ≥150 mg/dL (1.7 mmol/L) or drug treatment for elevated triglycerides
- Serum HDL cholesterol <40 mg/dL (1 mmol/L) in men and <50 mg/dL (1.3 mmol/L) in women or drug treatment for low HDL-C
- Blood pressure ≥130/85 mmHg or drug treatment for elevated blood pressure
- Fasting plasma glucose (FPG) ≥100 mg/dL (5.6 mmol/L) or drug treatment for elevated blood glucose.

International Diabetes Federation – The International Diabetes Federation (IDF) proposed a set of metabolic syndrome criteria in 2004 (*Alberti, KG et al. Lancet 2005; 366:1059*). Central obesity is an essential element in this definition, with different waist circumference thresholds set for different race/ethnicity groups:

- Increased waist circumference (table 2).

PLUS any two of the following:

- Triglycerides >150 mg/dL (1.7 mmol/L) or treatment for elevated triglycerides
- HDL cholesterol <40 mg/dL (1.03 mmol/l) in men or <50 mg/dL (1.29 mmol/l) in women, or treatment for low HDL
- Systolic blood pressure >130, diastolic blood pressure >85, or treatment for hypertension
- Fasting plasma glucose >100 mg/dL (5.6 mmol/L), or previously diagnosed type 2 diabetes. An oral glucose tolerance test is recommended for patients with an elevated fasting plasma glucose, but not required.

Potential other markers – The metabolic syndrome has been recognized as a proinflammatory, prothrombotic state, associated with elevated levels of C-reactive protein, interleukin (IL)-6, and plasminogen activator inhibitor (PAI)-1. The value of measurement or treatment of inflammatory or

vascular function markers in the setting of metabolic syndrome is unknown. Use of these markers should be considered for clinical purposes only in the setting of CVD risk assessment and reduction.

PREVALENCE AND RISK FACTORS – The prevalence of the metabolic syndrome in the general population, as defined by the 2001 ATP III criteria, was evaluated in 8814 adults in the United States participating in the third National Health and Nutrition Examination Survey (NHANES III, 1988 to 1994) (*Ford, ES et al. JAMA 2002; 287:356.*). The overall prevalence was 22 percent, with an age-dependent increase (6.7, 43.5, and 42.0 percent for ages 20 to 29, 60 to 69, and >70 years, respectively) (figure 1). Mexican-Americans had the highest age-adjusted prevalence (31.9 percent). Among African-Americans and Mexican-Americans, the prevalence was higher in women than in men (57 and 26 percent higher, respectively) (figure 2).

The metabolic syndrome is becoming increasingly common. Using data from the National Health and Nutrition Examination Survey 1999-2002 database, 34.5 percent of participants met ATP III criteria for the metabolic syndrome compared with 22 percent in NHANES III (1988 to 1994) (*Ford, ES et al. Diabetes Care 2005; 28:2745 - Ford, ES et al. JAMA 2002; 287:356.*). In addition, metabolic syndrome, defined by the 2005 revised ATP III criteria, was assessed in 3323 Framingham Heart Study participants, ages 22 to 81, who did not have diabetes or cardiovascular disease at a baseline examination in the early 1990s (*Wilson, PWF et al. Circulation 2005; 112:3066.*). At baseline, the prevalence of the metabolic syndrome was 26.8 percent in men and 16.6 percent in women. After eight years of follow-up, there was an age-adjusted 56 percent increase in prevalence among men and a 47 percent increase among women.

Increased weight – Increased body weight is a major risk factor for the metabolic syndrome. In NHANES III, the metabolic syndrome was present in 5 percent of those at normal weight, 22 percent of those who were overweight, and 60 percent of those who were obese (*Park, YW et al. Arch Intern Med 2003; 163:427.*).

In the Framingham Heart Study cohort, an increase in weight of 2.25 kg or more over 16 years was associated with a 21 to 45 percent increase in the risk for developing the syndrome (*Wilson, PW, et al. Arch Intern Med 1999; 159:1104*).

The rapidly increasing prevalence of obesity among adults is likely to lead to even higher rates of the metabolic syndrome in the near future (*Mokdad, AH et al. JAMA 1999; 282:1519.*), highlighting the importance of obesity prevention and improving physical activity levels.

Among seafarers epidemiological studies are spares. A Danish study based on a large random sample of seafarers having a pre-employment health showed that a large proportion was overweigh*t (Hoeyer JL et al. Int Marit Health. 2005;56(1-4):48-55*). When comparing the study with data from The National Institute of Public Health in Denmark (6,064 male Danes between 16 and 66 years) (5), a higher percentage of the seafarers in all three age groups were overweight. In the age group 16-24

years, 39.6% of the seafarers had a BMI on 25 or above versus 22.5% among the general population (relative risk (RR) 1.76 (1.36-2.28)). For the age group 25-44 the corresponding figures are 57.3% versus 45.4% (RR 1.26 (1.16-1.37)) and for the age group 45-66 years the percentages are 76.6% versus 48% (RR 1.57 (1.48-1.67)). The difference between Nordic seafarers and male Danes was even more apparent among the obese with BMI at 30 or above: 9% versus 5% the 16-24 year group, 18% versus 7.3% in the 25-44 year group, and 31% versus 13% in the 45-66 year group. Another study from Spain based on 439 seafarers having a pre-embarkment health examination also showed that a large proportion of them were overweight. According to ATP III criteria, an average of thirty percent of the sample had a metabolic syndrome without no statistical differences between fishermen and merchantmen groups (*Tristancho R et al, Medicina Maritime 2002; 2 (4): 43*).

Other factors – In addition to age, race, and weight, other factors associated with an increased risk of metabolic syndrome in NHANES III included postmenopausal status, smoking, low household income, high carbohydrate diet, no alcohol consumption, and physical inactivity (*LaMonte MJ, et al. Circulation 2005; 112:505.*). In the Framingham Heart Study, soft drink consumption was also associated with an increased risk of developing adverse metabolic traits and the metabolic syndrome (*Dhingra, R, et al. Circulation 2007; 116:480.*). In addition, poor cardiorespiratory fitness is an independent and strong predictor of metabolic syndrome in both men and women (*LaMonte, MJ, et al. Circulation 2005; 112:505).*

CLINICAL IMPLICATIONS – The metabolic syndrome is an important risk factor for subsequent development of type 2 diabetes and/or CVD. Thus, the key clinical implication of a diagnosis of metabolic syndrome is identification of a patient who needs aggressive lifestyle modification focused on weight reduction and increased physical activity (table 3).

Risk of type 2 diabetes – Prospective observational studies demonstrate a strong association between the metabolic syndrome and the risk for subsequent development of type 2 diabetes (*Hanson, RL, et al. Diabetes 2002; 51:3120*). In a meta-analysis of 16 multi-ethnic cohort studies, the relative risk of developing diabetes ranged from 3.53 to 5.17, depending upon the definition of metabolic syndrome and the population studied (*Ford, ES, et al. Diabetes Care 2008; 31:1898.*).

Risk of CVD – Three meta-analyses, which included many of the same studies, found that the metabolic syndrome increases the risk for incident cardiovascular disease (CVD) (RRs ranging from 1.53 to 2.18) and all cause mortality (RRs 1.27 to 1.60) (*Ford, ES et al. Diabetes Care 2005; 28:1769. - Galassi, A et al. Am J Med 2006; 119:812. - Gami, AS et al. J Am Coll Cardiol 2007; 49:403.).*

The increased risk appears to be related to the risk factor clustering or insulin resistance associated with the metabolic syndrome rather than simply to obesity. This was illustrated by the following studies : In a study of the Framingham population, obese people without metabolic syndrome did not have a significantly increased risk of diabetes or CVD (*Meigs, JB et al. J Clin Endocrinol Metab 2006; 91:2906*). Obese people with the metabolic syndrome had a 10-fold increased risk for diabetes and a

twofold increased risk for CVD relative to normal weight people without the metabolic syndrome. Normal weight people meeting revised 2005 ATP III criteria for the metabolic syndrome had a fourfold increased risk for diabetes and a threefold increased risk for CVD. In a study of 211 moderately obese (BMI 30 to 35) men and women, insulin sensitivity varied six-fold, and those with the greatest degree of insulin resistance had the highest blood pressure, triglyceride concentrations, fasting and two-hour post oral glucose blood sugar levels, and the lowest HDL concentrations, despite equal levels of obesity (*McLaughlin HG et al. Arch Intern Med 2007; 167:642.*).

Thus, not all moderately obese individuals have the same risk for developing cardiovascular disease or diabetes; risks differ as a function of insulin sensitivity, with insulin-resistant, obese individuals at highest risk.

Other associations – The metabolic syndrome has also been associated with several obesity-related disorders including:

- Fatty liver disease with steatosis, fibrosis, and cirrhosis *(Marceau, P, et al. J Clin Endocrinol Metab 1999; 84:1513. - Hamaguchi, M, et al. Ann Intern Med 2005; 143:722. - Hanley, AJ et al. Diabetes 2005; 54:3140).* Most patients with Non Alcoholic SteatoHepatitis (NASH) are asymptomatic although fatigue, malaise, and vague right upper abdominal discomfort bring some patients to medical attention. The most common presentation is elevation of liver aminotransferases detected on routine laboratory testing. Hepatomegaly is a frequent finding. Serum AST and ALT are elevated in almost 90 percent of patients. The AST/ALT ratio is usually less than 1; this is much lower than the ratio in alcoholic hepatitis, which is usually above 2 and averaged 2.85 in one report and 2.6 in another (*Sorbi, D et al. Am J Gastroenterol 1999; 94:1018.*).
- Chronic kidney disease (CKD) defined as a glomerular filtration rate less than 60 mL/min per 1.73 m2) and microalbuminuria.
- Polycystic ovary syndrome.
- Sleep-disordered breathing, including obstructive sleep apnea.
- Hyperuricemia and gout.

Several components of the metabolic syndrome, including hyperlipidemia, hypertension, and diabetes have been associated with an increased risk of cognitive decline and dementia. The metabolic syndrome (when associated with a high level of inflammation) may also be associated with cognitive decline in the elderly.

THERAPY – In 2001, ATP III recommended two major therapeutic goals in patients with the metabolic syndrome (*JAMA 2001; 285:2486.*). These goals were reinforced by a report from the American Heart Association and the National Institutes of Health (table 3) :

- Treat underlying causes (overweight/obesity and physical inactivity) by intensifying weight management and increasing physical activity.

- Treat cardiovascular risk factors if they persist despite lifestyle modification.

There is no direct evidence that attempting to prevent type 2 diabetes and CVD by treating the metabolic syndrome is as effective as attaining the above goals. It is possible to treat insulin resistance with drugs that enhance insulin action (eg, thiazolidinediones and metformin). However, the ability of such an approach to improve outcomes compared to weight reduction and exercise alone is not yet well supported by clinical trials (*Meigs, JB. BMJ 2003; 327:61 - Knowler, WC, et al. N Engl J Med 2002; 346:393.*).

Lifestyle modification – Prevention or reduction of obesity, particularly abdominal obesity, is the main therapeutic goal in patients with the metabolic syndrome (*Manson, JE, et al. Arch Intern Med 2004; 164:249.*).

Weight reduction is optimally achieved with a multimodality approach including diet, exercise, and possible pharmacologic therapy, as with orlistat (*Reaven, G, et al. Am J Cardiol 2001; 87:827*).

Diet – Several dietary approaches have been advocated for treatment of the metabolic syndrome. Most patients with the metabolic syndrome are overweight, and weight reduction, which improves insulin sensitivity, is an important outcome goal of any diet. The following specific diet approaches have been recommended:

- The Mediterranean diet may be beneficial (*Tortosa, A, et al. Diabetes Care 2007; 30:2957.*). In a study comparing the Mediterranean diet (high in fruits, vegetables, nuts, whole grains, and olive oil) with a low-fat prudent diet, subjects in the Mediterranean diet group had greater weight loss, lower blood pressure, improved lipid profiles, improved insulin resistance, and lower levels of markers of inflammation and endothelial function.
- The DASH diet (daily sodium intake limited to 2400 mg, and higher in dairy intake than the Mediterranean diet), compared to a weight reducing diet emphasizing healthy food choices, resulted in greater improvements in triglycerides, diastolic blood pressure, and fasting glucose, even after controlling for weight loss.

Exercise – Exercise may be beneficial beyond its effect on weight loss by more selectively removing abdominal fat, at least in women. Current physical activity guidelines recommend practical, regular, and moderate regimens for exercise. The standard exercise recommendation is a daily minimum of 30 minutes of moderate-intensity (such as brisk walking) physical activity. Increasing the level of physical activity appears to further enhance the beneficial effect.

Prevention of type 2 diabetes – Although not strictly addressing the metabolic syndrome, clinical trials have shown that lifestyle modifications can substantially reduce the risk of development of type 2 diabetes and the levels of risk factors for CVD in patients at increased risk.

Oral hypoglycemic agents – Among the oral hypoglycemic agents used to treat type 2 diabetes, metformin and the thiazolidinediones (rosiglitazone and pioglitazone) improve glucose tolerance in part by enhancing insulin sensitivity. The role of these agents in patients with metabolic syndrome, to prevent diabetes, has not been definitively established. Routine pharmacoprevention for diabetes with any agent is not recommended.

Cardiovascular risk reduction – Reduction of risk factors for cardiovascular disease includes treatment of hypertension, cessation of smoking, glycemic control in patients with diabetes, and lowering of serum cholesterol according to recommended guidelines.

Lipid-lowering – ATP III recommended a goal serum LDL cholesterol of less than 100 mg/dL (2.6 mmol/L) for secondary prevention in patients with type 2 diabetes, and subsequent studies have suggested a more aggressive goal of less than 80 mg/dL (2.1 mmol/L) with a regimen that includes administration of a statin.

Antihypertensive therapy – Hypertension control is important in patients with diabetes mellitus. The goal blood pressure may be somewhat lower than that in the general population and varies with the presence or absence of diabetic nephropathy with proteinuria. It is not clear if the lower goal applies to patients with metabolic syndrome, but it may be reasonable to aim for such a goal. The value of ACE inhibitors and ARBs in hypertensive patients with the metabolic syndrome who do not have CVD or diabetes is not known.

Identification of patients at high metabolic risk – Health care providers should assess individuals for metabolic risk at routine clinic visits. The US Endocrine Society clinical guidelines suggest evaluation at three-year intervals in individuals with one or more risk factors. The assessment should include measurement of blood pressure, waist circumference, fasting lipid profile, and fasting glucose.

In patients identified as having the metabolic syndrome (table 1), aggressive lifestyle intervention (weight reduction, physical activity) is warranted to reduce the risks of type 2 diabetes and cardiovascular disease. Assessment of 10-year risk for cardiovascular disease, using a risk assessment algorithm, such as the Framingham Risk Score or SCORE, is useful in targeting individuals for medical intervention to lower blood pressure and cholesterol.

Obesity is a common cause of physical incapacity in serving seafarers. Other causes of physical incapacity include musculoskeletal disease and injury and limited heart and lung function. All these causes can interact as obesity raises the demands on the heart and lungs during exercise and also increases the risk of future musculoskeletal damage and heart disease.

Targets based on reductions in measured obesity or on improved performance at capability tests are effective motivational tools to use to secure weight reductions and fitness improvements.

Approaches to decision taking on obesity

Because weight gain is progressive and can be controlled by the individual in most cases given suitable dietary choices, an approach which aims to halt weight gain before it reaches a level where it can cause risks and which encourages weight loss is needed. This can be re-enforced with the prospect of limitations to employment, if weight has reached a level where unacceptable levels of risk are imminent.

Advice on diet and weight reduction, with targets set. This can be backed by wider screening for risk factors, especially for ischemic vascular disease and diabetes.

Approach to a proposition of Research

The increase in prevalence of overweight and the related diseases in the general population and in the maritime professions as well, calls for more activity in prevention. There is a lack of experience of effectual interventions in the population in general and there are no significant experiences in seafaring. There are, however, some evidences showing effectual prevention of further aggravation of overweight and the related diseases in the high risk groups (e.g. pre- diabetes).
This program covers the whole maritime population, but due to the lack of positive prevention experiences for the low risk groups, only high risk groups may be offered specific prevention (part 3).
The program will be managed centrally of one of the participant countries and each of the other participating countries will deliver their specific parts to the program. They will contribute with a part, they are ready to perform. Spain for example has a data register with measurements of Body Mass Index in seafaring (mainly fishermen) for at least 20 years and can provide an excellent overview of the development of BMI.
At the end of the program, all useful experiences for the prevention will be made available as standard prevention programs in seafaring as widely as possible.

Target groups: fishing and seafaring in Europe as an starting point

General aim: To minimize e.g. overweight and to prevent the diseases and unfitness for work related to overweight in the target group

Purposes:
1. To describe the status and the development of prevalence of overweight in 20 years in the population to point out the most serious and vulnerable parts of the population – suitable for intervention.
2. To describe the main causes for negative and positive development of the ill-health to be used for selection of preventive action (knowledge, style of life, education, training, and society related factors) in seafarers and fishermen, their families, owners, manning agencies, curriculum of training courses
3. To perform an experimental studies with the objective of:
1) change bad dietary and bad exercise habits in the target population
2) change the conditions on the ships so it is possible for the target group to change the habits

Hypothesis: it is possible to prevent the development of diseases and non-fit for duty related to overweight by offering a programme specific designed for the high-risk group

Methods in general:
European collaboration study, for the EC 7 FP Mediterranean and East Europe countries have preference. Each country oblige to deliver one or more of the study parts of the programme. Use recognized methods for prevention: knowledge changes and change of hardware (possibilities, training rooms etc..)

Epidemiological studies backswords in the population for purpose 1
Qualitative methods for causal study for purpose 2
For 5 years: an intervention epidemiological study for purpose 3

Multi-skilled project group

Epidemiological and qualitative methods:
Part 1: Prevalence study in 20 years backswords
Part 2: causal study – qualitative and epidemiological
Part 3: Experimental study with two study groups: A= intervention group, B=control group. Epidemiologic study of the type: before and after study with comparison between A and B groups will be performed.

Part 3: Intervention programme, Group A: Advice and training is given on several levels:
1) during visits in the clinic regularly (every month or other intervals) for the fisherman/seafarer
2) visits and advice at home in the family
3) visit on board in the kitchen
4) specific training course for the cooks on board
5) training courses for the wives

Intervention, Group B: fishermen/ seafarers get the relevant basic information (possibly coordinated with the SHIP project)

Programme and analysis of the intervention part study:

	Start, equal manner in A or B,	Intervention programme:	Stop equal in A and B
A	Questionnaires + lab test+ anthropometric data	1) Intervention programme 2) 2) Regular visits with: Questionnaires + lab test + anthropometric data	Questionnaires + lab test + anthropometric data
B	Questionnaires + lab test+ anthropometric data	No programme, no regular visits Information is given	Questionnaires + lab test + anthropometric data
		Follow up 2-4 years	

GRAPHICS

Table 1 : Two Current definitions of the metabolic syndrome

Parameters	NCEP ATP3 2005	IDF 2005
Required		Waist ≥94 cm (men) or ≥80 cm (women)
Number of abnormalities	≥3 of:	And ≥2 of:
Glucose	≥5.6 mmol/L (100 mg/dL) or drug treatment for elevated blood glucose	≥5.6 mmol/L (100 mg/dL) or diagnosed diabetes
HDL cholesterol	<1.0 mmol/L (40 mg/dL) (men); <1.3 mmol/L (50 mg/dL) (women) or drug treatment for low HDL-C	<1.0 mmol/L (40 mg/dL) (men); <1.3 mmol/L (50 mg/dL) (women) or drug treatment for low HDL-C
Triglycerides	≥1.7 mmol/L (150 mg/dL) or drug treatment for elevated triglycerides	≥1.7 mmol/L (150 mg/dL) or drug treatment for high triglycerides
Obesity	Waist ≥102 cm (men) or ≥88 cm (women)	
Hypertension	≥130/85 mmHg or drug treatment for hypertension	≥130/85 mmHg or drug treatment for hypertension

NCEP: National Cholesterol Education Program; IDF: International Diabetes Federation; EGIR: Group for the Study of Insulin Resistance; HDL: high density lipoprotein; BMI: body mass index.

Table 2 : Ethnic specific values for waist circumference

Ethnic group	Waist circumference (as measure of central obesity)
Europids	
Men	≥94 cm
Women	≥80 cm
South Asians	
Men	≥90 cm
Women	≥80 cm
Chinese	
Men	≥90 cm
Women	≥80 cm
Japanese	
Men	≥85 cm
Women	≥90 cm
Ethnic South and Central Americans	Use South Asian recommendations until more specific data are available
Sub-Saharan Africans	Use European data until more specific data are available
Eastern Mediterranean and middle east (Arab) populations	Use European data until more specific data are available

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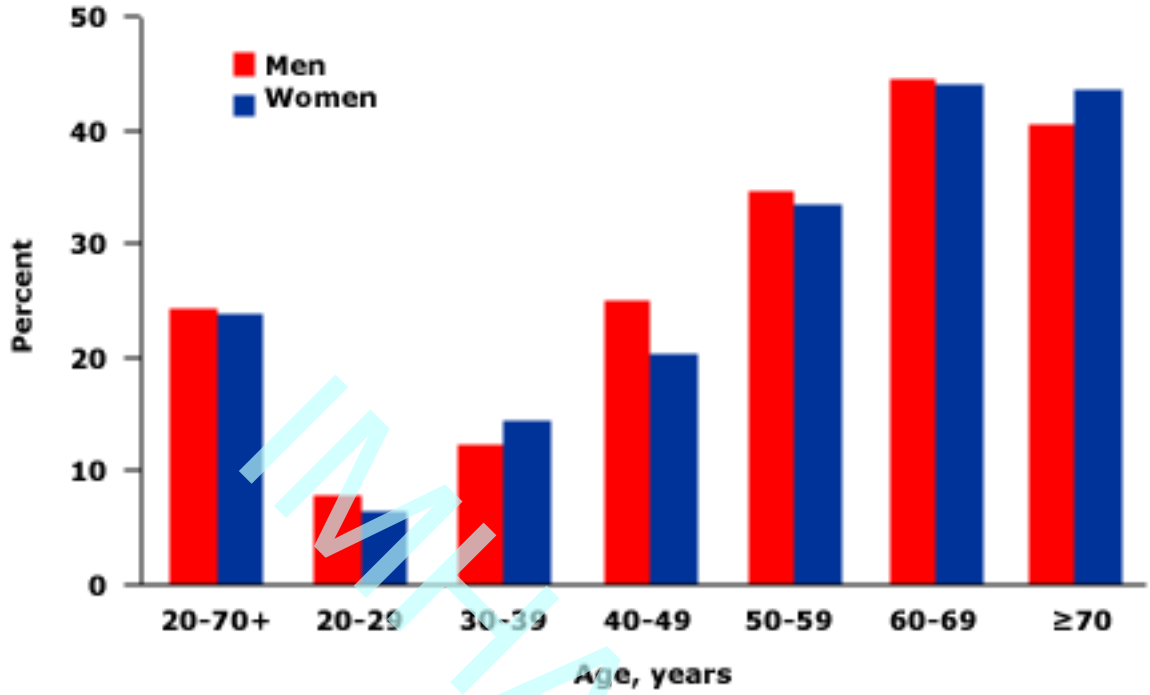
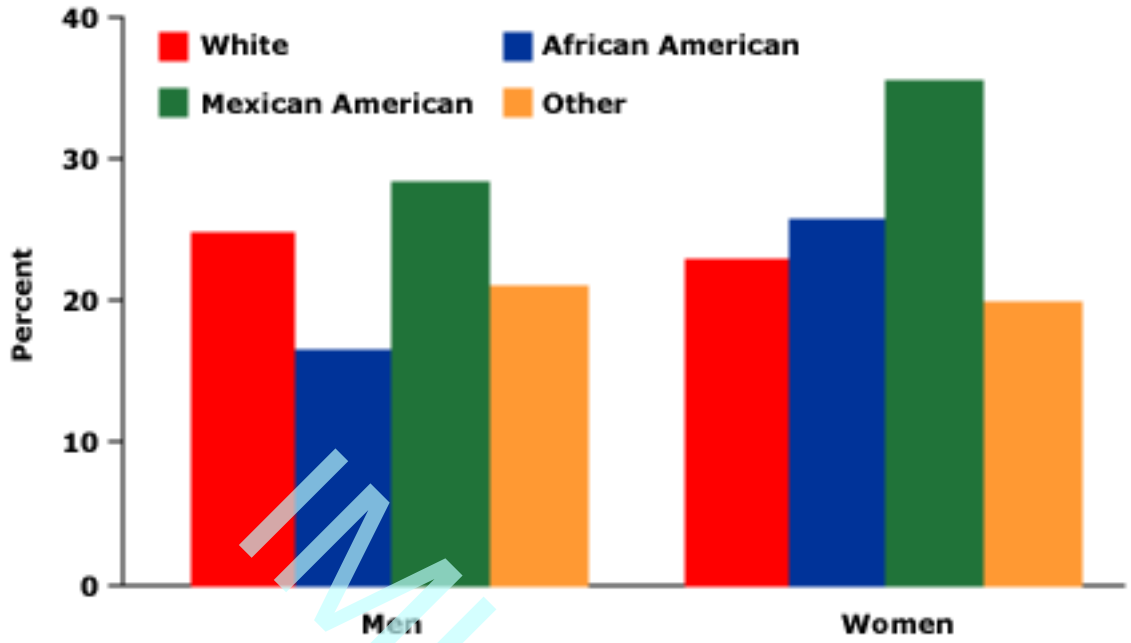
FIGURES

Figure 1 : Prevalence of NCEP ATP III metabolic syndrome among subjects in the NHANES III survey, by age



Adapted from Ford, ES, Giles, WH, Dietz, WH. Prevalence of the metabolic syndrome among US adults: findings from the third National Health and Nutrition Examination Survey. JAMA 2002; 287:356.

Figure 2 : Prevalence of NCEP ATP III metabolic syndrome among subjects in the NHANES III survey by race/ethnicity and sex



Adapted from Ford, ES, Giles, WH, Dietz, WH. Prevalence of the metabolic syndrome among US adults: findings from the third National Health and Nutrition Examination Survey. JAMA 2002; 287:356.

Table 3 : Therapeutic goals for management of metabolic syndrome

	Goals
Lifestyle risk factors	
Abdominal obesity	Year 1: reduce body weight 7-10 percent.
	Continue weight loss thereafter with ultimate goal BMI <25 kg/m2
Physical inactivity	At least 30 min (and preferably ≥60 min) continuous or intermittent moderate intensity exercise 5X/wk, but preferably daily
Atherogenic diet	Reduced intake saturate fat, trans fat, cholesterol
Metabolic risk factors	
Dyslipidemia	
Primary target elevated LDL-C	High risk*: <100 mg/dL (2.6 mmol/>L); optional <70 mg/dL
	Moderate risk: <130 mg/dL (3.4 mmol/L)
	Lower risk: <160 mg/dL (4.9 mmol/L)
Secondary target elevated non-HDL-C	High risk*: <130 mg/dL (3.4 mmol/L); optional <100 mg/dL (2.6 mmol/L) very high risk
	Moderate risk: <160 mg/dL (4.1 mmol/L)
	Lower risk: <190 mg/dL (4.9 mmol/L)
Tertiary target reduced HDL-C	Raise to extent possible w/weight reduction and exercise
Elevated bp	Reduce to at least <140/90 (<130/80 if diabetic)
Elevated glucose	For IFG, encourage weight reduction and exercise
	For type 2 DM, target A1C <7 percent
Prothrombotic state	Low dose aspirin for high risk patients

Proinflammatory state	Lifestyle therapies; no specific interventions

DM: diabetes mellitus; IFG: impaired fasting glucose; bp: blood pressure.
* High risk: diabetes, known coronary artery disease.
Data from: Grundy, S, Cleeman, J, Daniels, S, et al. Diagnosis and management of the metabolic syndrome. An American Heart Association/National Heart, Lung, and Blood Institute scientific statement. Circulation 2005; 112:2735.