Introduction
India’s population has been rapidly greying over the past few decades. Therefore, age-related cardiovascular disease (CVD) is likely to place an enormous burden on the resources of the individual as well as on the family, society and nation in the years to come.

The constellation of risk factors that predispose an individual to CVD has been termed the “metabolic syndrome (MS).” Obesity or excess body fat has been recognized as the central defect in most of the accepted definitions of MS. Overweight and obesity predispose to CVD in a variety of way and amplify the effect of old age on the vascular tree. Moreover, excess weight is also associated with a number of other co-morbidities in the elderly, which have the potential to seriously impact their quality of life and add to the burden on their caregivers. This chapter will review the problem of obesity and MS in old age and suggest ways and means by which the problem can be tackled.

Assessment of Obesity and Metabolic Syndrome
Traditionally, overweight and obesity have been assessed in terms of the body mass index (BMI), obtained by dividing the weight (in kg) by the square of the height (in metres). Individuals are classified as underweight, normal weight, overweight and obese as shown in Table 72.1. However, it was soon recognized that a single cut point was not sufficient for diagnosing obesity in various ethnic groups; for instance, Asian Indians develop the adverse metabolic consequences of obesity at lower levels of BMI than do white Caucasians.2 This led the World Health Organisation (WHO) to put forth revised cut-points for overweight and obesity for the Asia Pacific region, which are listed in Table 72.2.3

While the BMI is a good indicator of overall body adiposity, it gives no information as to how this fat is distributed in the body. It has been shown that deposition of fat in the abdominal region (the so called central or visceral obesity) is a far more robust predictor of adverse health outcomes than generalized obesity. The waist circumference remains the simplest and most practical test for assessing visceral obesity. In white Caucasians, a waist circumference ≥102 cm in men and 88 cm in women is considered as indicative of abdominal obesity.4 According to the International Diabetes Federation, the corresponding cut offs for South Asians are 90 cm and 80 cm, respectively for men and women.5

The most commonly used definitions for MS are those proposed by WHO, National Cholesterol Education Program (NCEP) and International Diabetes Federation (IDF).4-6 Table 72.3 compares the various definitions of MS.

### Table 72.1: BMI cutpoints for defining overweight and obesity

<table>
<thead>
<tr>
<th>BMI (kg/m²)</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;18.5</td>
<td>Underweight</td>
</tr>
<tr>
<td>18.5–24.9</td>
<td>Normal weight</td>
</tr>
<tr>
<td>25–29.9</td>
<td>Overweight</td>
</tr>
<tr>
<td>30–34.9</td>
<td>Class I Obesity</td>
</tr>
<tr>
<td>35–39.9</td>
<td>Class II Obesity</td>
</tr>
<tr>
<td>≥40</td>
<td>Class III Obesity</td>
</tr>
</tbody>
</table>

### Table 72.2: Revised Asia Pacific BMI cutpoints for defining overweight and obesity

<table>
<thead>
<tr>
<th>BMI (kg/m²)</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>18–22.9</td>
<td>Normal</td>
</tr>
<tr>
<td>23–24.9</td>
<td>Overweight</td>
</tr>
<tr>
<td>≥25</td>
<td>Obese</td>
</tr>
</tbody>
</table>

### Table 72.3: Various definitions of MS

<table>
<thead>
<tr>
<th>Definition</th>
<th>Cutoffs</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHO</td>
<td>30.0</td>
</tr>
<tr>
<td>NCEP</td>
<td>30.0</td>
</tr>
<tr>
<td>IDF</td>
<td>27.5</td>
</tr>
<tr>
<td>JNC II</td>
<td>27.5</td>
</tr>
<tr>
<td>JNC III</td>
<td>25.0</td>
</tr>
<tr>
<td>AWHC</td>
<td>25.0</td>
</tr>
</tbody>
</table>
Epidemiology of Obesity in Elderly

**International Data**

Studies from European countries indicate that the prevalence of obesity increases till about age 60, after which it plateaus and may even decline (Fig. 72.1). However, recent data from Scotland showed a disproportionate increase in waist circumference compared to body mass index in subjects aged 50–70 years, between the years 1998–2008, indicating that these subjects not only gained visceral fat but also lost lean muscle mass as they aged. In the US, data from the Department of Health and Human Services show that almost 35% of adults aged 65 years and above were either overweight or obese, as of 2010.

**Indian Data**

There are a few data from India on the prevalence of obesity in older adults. In a study from Delhi on 206 consecutive subjects attending the Geriatric clinic of a tertiary care hospital, it was found that 34% of men and 49% of women were either overweight or obese. A population-based study of 362 individuals aged 65 and above from Chandigarh found that 29.9% of men and 42.1% of women were overweight or obese. The above two studies defined overweight and obesity based on the global BMI cut-points and did not use the Asia Pacific cut-off values. In the Chennai Urban Rural Epidemiology Study (CURES) conducted on a representative sample of 26,001 individuals...

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**Table 72.3: Definitions of the Metabolic Syndrome**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>WHO</th>
<th>NCEP-ATP III</th>
<th>IDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis</td>
<td>DM, IGT, IFG or insulin resistance with 2 or more of the following</td>
<td>Three or more of the following</td>
<td>Central obesity and 2 or more of the following</td>
</tr>
<tr>
<td>Fasting glucose (mg/dL)</td>
<td>≥110</td>
<td>≥100 or on treatment for DM</td>
<td>≥100 or on treatment for DM</td>
</tr>
<tr>
<td>Obesity</td>
<td>Central obesity (WHR &gt;0.9 in males and &gt;0.85 in females) and/or BMi &gt;30 kg/m²</td>
<td>Waist circumference &gt;102 cm in males or &gt;88 cm in females</td>
<td>Ethnic specific cut-offs; waist circumference &gt;90 cm in males and &gt;80 cm in females for South Asians</td>
</tr>
<tr>
<td>Blood pressure (mmHg)</td>
<td>&gt;140/90</td>
<td>&gt;130/85, or on treatment</td>
<td>&gt;130/85, or on treatment</td>
</tr>
<tr>
<td>Triglyceride (mg/dL)</td>
<td>≥150 and/or</td>
<td>≥150, or on treatment</td>
<td>≥150, or on treatment</td>
</tr>
<tr>
<td>HDL cholesterol (mg/dL)</td>
<td>&lt;35 in males and &lt;40 in females</td>
<td>&lt;40 in males and &lt;50 in females</td>
<td>&lt;40 in males and &lt;50 in females, or on treatment</td>
</tr>
<tr>
<td>Other criteria</td>
<td>Microalbuminuria</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

WHO: World Health Organization; NCEP-ATP III: National Cholesterol Education Programme Adult Treatment Panel III; IDF: International Diabetes Federation; DM: Diabetes mellitus; IGT: Impaired glucose tolerance; IFG: Impaired fasting glucose; WHR: Waist-hip ratio; BMI: Body mass index; HDL: High density lipoprotein
in Chennai showed that the prevalence rates of overweight and obesity in persons aged above 65 years were 28.1 and 10.7%, respectively, based on the Asia Pacific cutoffs for BMI. Central obesity, as defined by the IDF cutoffs for waist circumference, was present in 38.5% of the elders studied (CURES, unpublished). A more recent study on 214 subjects from Puducherry found the prevalence of obesity based on the global BMI guidelines to be 7.5%; however, the prevalence of abdominal obesity as measured by the waist circumference was much higher (40%).

Health Consequences of Obesity in Elderly

Obesity and DM
Obesity, particularly visceral obesity, is a major risk factor for type 2 DM. The incidence of type 2 diabetes increases with age, partly on account of the increased ratio of total body fat to lean body mass found in old age. Visceral adipocytes are known to produce adipocytokines that can adversely affect insulin sensitivity as well as pancreatic β-cell function, thereby contributing to the development of diabetes.

Obesity and Hypertension
Old age and obesity are two of the strongest risk factors for uncontrolled hypertension. Obesity can lead to increased peripheral resistance and increased cardiac output along with increased sympathetic tone. These changes amplify the changes in the vasculature, which are a corollary of normal aging, leading to difficult to control hypertension.

Obesity and Arthritis
Weight gain can lead to osteoarthritis of the weight bearing joints, leading to reduction in physical activity and a further increase in weight. Increased inflammatory response may also play a role in the propensity of obese individuals to develop arthritis.

Obesity and Respiratory Disease
Weight gain places excess demand on the respiratory system of the elderly individual. Failure to meet this demand leads to shortness of breath even on mild exertion, thereby curtailing the individual’s activities and predisposing him or her to further weight gain. Other penalties of obesity on the respiratory system include obstructive sleep apnea and the obesity–hyperventilation syndrome. These can further reduce the quality of life in elderly subjects and can have more serious consequences including CVD.

Obesity and Quality of Life
Several studies show that obesity is associated with increased difficulty in performing activities of daily living in elderly individuals of either sex. Frailty has also been shown to be positively linked with obesity. Conversely, it has been shown that weight loss and physical activity can reduce frailty in older obese adults.

Obesity also adversely impacts quality of life through its effects on cognitive function. Obesity in middle age has been linked to Alzheimer’s disease and vascular dementia.

The Obesity Paradox
Obese subjects with certain health hazards have been shown to fare better than their non-obese counterparts: a phenomenon called the “obesity paradox.” These hazards include coronary artery disease in hypertensive subjects, chronic kidney disease, congestive heart failure, hemodialysis, postcoronary revascularization and some cases of non ST elevation myocardial infarction. It is not clear how obesity leads to a favorable outcome in these conditions, especially as it is in itself a major risk factor for the initial development of these very hazards. Also, it is not clear to what extent this paradox applies to elderly subjects.

However, obesity has been unequivocally linked to increased bone mineral density in elderly subjects and this in turn translates to a lower risk of hip fractures. This may be due to increased bone resilience, but also because the excess adipose tissue cushions the bone in the event of a fall.

Obesity and Cardiovascular Disease
Currently available data support an association between obesity, particularly visceral obesity and risk of CVD. The data is most clear cut for coronary heart disease while that for cerebrovascular disease is conflicting. The Health Professionals’ Follow-up Study and the Physicians’ Health Study have both clearly linked abdominal adiposity to increased CVD risk. Similar data have also emerged from China, Brazil and Sweden.  

Obesity and Mortality
There has been some controversy on the impact of higher BMI on mortality risk from all cause mortality in elderly individuals. Although the mortality risk rises with increasing BMI for all ages, there is an apparent decline in the relative added risk contributed by obesity in the elderly. This apparent paradox may be due to the fact that conditions such as smoking and malignancy, which are associated with low BMI may account for a disproportionately high number of deaths in this age group and thereby mask the effects of obesity on mortality. Also, many of the most “vulnerable” section of the obese population succumb during
later middle life, leaving only the otherwise biologically advantaged “survivors” to be included in analyses of mortality, thereby biasing the results (survivor bias).

Metabolic Syndrome in Elderly
Increased abdominal adiposity has been linked to most of the abnormalities constituting the metabolic syndrome. The occurrence of MS peaks in the 6th decade in males and 7th decade in females, and declines only for men in the 8th decade, if at all. In most high income countries, the prevalence of MS is around 20%, and this increases with age. In the third National Health and Nutrition Examination Survey (NHANES III), the prevalence of MS was found to be 44% in individuals aged 60–69 years and 42% in those aged 70 and above.

There is a paucity of data from India on MS in the elderly. In the CURES population mentioned above, the prevalence of MS in subjects aged 65 years and above was 23.2% based on the WHO criteria, 25.8% based on the IDF criteria, and 29.9% based on the modified NCEP criteria (CURES, unpublished).

Management of Obesity and Metabolic Syndrome in Elderly
Treatment of obesity should include not only management of increased body weight per se but also management of its metabolic consequences such as DM, hypertension and hyperlipidemia.

Lifestyle Modification
Dietary modification and increased physical activity form the cornerstone of any weight loss plan. A combination of a moderate energy deficit diet and increased physical activity can bring about a weight loss of 8–10% in 6 months. Exercise can also improve physical function and frailty. However, comorbidities such as impaired vision and hearing may interfere with physical activity in some cases.

While planning a diet for elderly subjects, care should be taken to ensure adequate intake of protein while energy restriction should be moderate, so as to combat the sarcopenia associated with aging. However, excess carbohydrate intake should be avoided as this can blunt the anabolic response of the body to high quality protein.

Drug Therapy for Obesity
Orlistat, a pancreatic lipase inhibitor, is currently the only drug licensed for treatment of obesity. When added to diet and exercise, orlistat results in a 2–3 kg additional weight loss compared to placebo. While there have been no clinical trials on orlistat specifically in the elderly, sub-analyses of the older participants in earlier trials showed this agent to be as effective in elderly subjects as in the general population. Unfortunately, the drug is not free of side effects.

Surgical Therapy
Bariatric surgical procedures have now emerged as the most effective treatment modalities for obesity. While the earliest guidelines restricted these procedures to individuals aged between 18 and 50 years, many centers now routinely perform these surgeries on individuals far exceeding these age limits.

While the results of bariatric surgery in the elderly have been impressive, both with regards to weight loss as well as improvement in co-morbidities, older obese subjects often require more medications before surgery than younger subjects. Considering the favourable risk: benefit ratio, bariatric surgery should not be denied to an elderly individual solely on age grounds.

Management of Diabetes and Hypertension in Elderly
The management of these conditions follows the same general principles as in younger subjects, with a few important differences. The details will be dealt with in the respective chapters of this book and are not further described here.

Management of Dyslipidemia in Elderly
Elderly patients derive as much benefit from lipid lowering therapy as do younger subjects. Therapy with HMG CoA reductase inhibitors (“statins”) has been found to reduce the first CV event, mortality from CV events and all-cause mortality in elderly subjects.

Conclusion
Obesity is a major contributor to morbidity and mortality at all ages and the elderly are no exception. Overweight and obesity contribute to a constellation of risk factors leading to increased propensity to CVD known as the metabolic syndrome. The individual components of the syndrome such as DM, hypertension and dyslipidemia are also potential killers in their own right. Elderly subjects respond as well to therapy targeted at obesity and its co-morbidities as younger subjects do, with little or no increase in treatment related side effects. It is therefore imperative that these therapeutic options are offered to all individuals suffering from these conditions, irrespective of age, so that the excess morbidity and mortality associated with obesity can be avoided.
Key Messages

1. Obesity in the elderly is a growing problem in India.
2. Ethnic specific criteria are preferred for assessment of obesity in Indians.
3. Obesity has numerous health penalties involving almost every system of the body.
4. MS is also seen in the elderly.
5. From the clinicians point of view, treatment of MS is treatment of its individual components like glucose intolerance, obesity, hypertension and dyslipidemia.
6. The elderly respond as well to treatment for obesity and metabolic syndrome as do younger individuals, but drugs should be carefully chosen.

References