Obesity and the Metabolic Syndrome in Developing Countries: Focus on South Asians

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Abstract

With improvement in the economic situation, an increasing prevalence of obesity and the metabolic syndrome is seen in developing countries in South Asia. Particularly vulnerable population groups include women and children, and intra-country and inter-country migrants. The main causes are increasing urbanization, nutrition transition, reduced physical activity, and genetic predisposition. Some evidence suggests that widely prevalent perinatal undernutrition and childhood ‘catch-up’ obesity may play a role in adult-onset metabolic syndrome and type 2 diabetes. Data show that atherogenic dyslipidemia, glucose intolerance, thrombotic tendency, subclinical inflammation, and endothelial dysfunction are higher in South Asians than white Caucasians. Many of these manifestations are more severe even at an early age in South Asians than white Caucasians. Metabolic and cardiovascular risks in South Asians are also heightened by their higher body fat, truncal subcutaneous fat, intra-abdominal fat, and ectopic fat deposition (liver fat, muscle fat, etc.). Further, cardiovascular risk cluster manifests at a lower level of adiposity and abdominal obesity. The cutoffs of body mass index and waist circumference for defining obesity and abdominal obesity, respectively, have been lowered for Asians, and same has been endorsed for South Asians in the UK. The economic cost of obesity and related diseases in developing countries, having meager health budget, is enormous. Increasing awareness of these noncommunicable diseases and how to prevent them should be focus of population-wide prevention strategies in South Asian developing countries. Community intervention programs focusing on increased physical activity and healthier food options for schoolchildren are urgently required. Data from such a major intervention program con-
ducted by us on adolescent urban schoolchildren in north India (project MARG) have shown encouraging results and could serve as a model for initiating such programs in other South Asian developing countries.

Developing countries, particularly South Asia, are witnessing a rapid increase seen in type 2 diabetes mellitus (T2DM) and coronary heart disease (CHD) [1]. During the previous three decades, the prevalence of T2DM has doubled in India. Insulin resistance and clustering of other proatherogenic factors (the metabolic syndrome), frequently seen in South Asians, are important contributory factors for T2DM and CHD [2].

Rapid demographic, nutritional, and economic changes are occurring in South Asians [1]. The life expectancy and percentage of elderly population have increased. Most importantly, globalization of diets and consumption of nontraditional ‘fast-foods’ have occurred at a rapid pace in urban areas. Furthermore, these dietary changes are most noticeable in children. In South Asian countries, rapid increase in western fast-food outlets, sale of aerated sweet drinks and increased consumption of fried snacks in school children are being commonly seen [3]. In addition, South Asians are less physically active, and sedentary lifestyle is increasing, particularly in children [1, 4]. Further, migration from villages to cities is increasing. These intra-country migrants become urbanized, mechanized, resulting in nutritional imbalance, physical inactivity, stress, and increased consumption of alcohol and tobacco [5].

Nationally representative studies regarding the prevalence of the metabolic syndrome are generally not available from any South Asian country. Available data indicate that the prevalence of the metabolic syndrome in Asian Indians varies according to region, extent of urbanization, lifestyle patterns and socioeconomic/cultural factors [1–2, 6–8]. Recent data show that about one third of the urban population in large cities in India has the metabolic syndrome [1]. The interaction of various factors which could contribute to insulin resistance, diabetes, and CHD is shown in figure 1.

The phenotype of obesity and body fat distribution are distinctive in South Asians and are important contributory factors in the development of insulin resistance and the metabolic syndrome [1–2, 9]. Key points have been summarized below.

1 Average body mass index (BMI) value in South Asians is lower than that seen in white Caucasians, Mexican-Americans and Blacks. However, BMI in Asian Indians increases as they become affluent and urbanized [1, 2].

2 South Asians have a high percentage of body fat as compared to white Caucasians and Blacks, despite lower average BMI values, which is partly explained by body build (trunk-to-leg length ratio and slenderness),
muscularity, adaptation to chronic calorie deprivation, and ethnicity. Higher body fat seen in South Asians than Caucasians at similar BMI was clearly demonstrable in Asian Indians based in Singapore who showed BMI to be 3 lower than white Caucasians at any given percentage of body fat [1–2, 10].

3 Importantly, morbidities related to excess adiposity (diabetes, hypertension, dyslipidemia) occur more frequently at lower BMI levels in Asians than in white Caucasians [1, 10].

4 High prevalence of abdominal obesity has been reported in South Asians by several investigators, and is also seen in Asian Indians with BMI <25 [6, 10–12]. Further, although the average waist circumference in South Asians appears to be lower, abdominal adiposity as measured by computerized axial topography is significantly more than in white Caucasians [10]. Based on these data, classification of obesity has been revised for Asian Indians (table 1) [13, 14]. These cutoffs have been endorsed for South Asians in UK recently [15].

5 Intra-abdominal adipose tissue in South Asians is comparatively more than white Caucasians [9, 10, 12].

6 Truncal subcutaneous adipose tissue (measured by subcapular and supra-iliac skinfolds) is thicker in South Asians than white Caucasians (in both...
adults and children), correlating more closely with insulin resistance than intra-abdominal adipose tissue [1].

7 The fat is deposited in excess in ‘ectopic sites’: skeletal muscles, liver, etc. The latter is comparatively higher in Asian Indians as compared to white Caucasians and correlates with insulin resistance [10]. This appears to have strong genetic influence [16–20].

8 Finally, South Asians appear to be ‘metabolically obese’, though BMI levels may fall into the category of ‘nonobese’. This phenomenon is partially explained by excess body fat, high intra-abdominal and subcutaneous fat, and ectopic fat deposition in various organs and body sites, which may contribute to insulin resistance, dyslipidemia, hyperglycemia, and excess procoagulant factors in South Asians [1, 21].

**Prevention and Control of Obesity and the Metabolic Syndrome in South Asians**

Prevention of these conditions requires early and aggressive management based on the following key principles.

1 Intensive efforts should be made to make South Asians aware that they are at higher risk for development of T2DM and CHD than other ethnic groups.

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**Table 1.** Consensus guidelines for defining obesity, abdominal obesity and the metabolic syndrome in Asian Indians, adapted from Misra et al. [13]

<table>
<thead>
<tr>
<th>Generalized obesity (BMI¹ cutoffs)</th>
<th>Abdominal obesity (waist circumference cutoffs)</th>
<th>The metabolic syndrome²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal: 18.0–22.9</td>
<td>Men: ≥90 cm</td>
<td>Abdominal obesity: waist circumference cutoffs as defined in previous column (nonobligatory)</td>
</tr>
<tr>
<td>Overweight: 23.0–24.9</td>
<td>Women: ≥80 cm</td>
<td>Blood glucose: ≥100 mg/dl</td>
</tr>
<tr>
<td>Obesity: &gt;25</td>
<td></td>
<td>Hypertension: ≥130/≥85 mm Hg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triglycerides: ≥150 mg/dl</td>
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<tr>
<td></td>
<td></td>
<td>HDL-C: males &lt;40 mg/dl, females &lt;50 mg/dl</td>
</tr>
</tbody>
</table>

¹ Calculated as kg/m².
² No parameter is obligatory; three out of five need to be present to diagnose the metabolic syndrome.
2 Preventive measures should be particularly vigorous for those with the family history of T2DM or premature CHD.

3 Adequate nutrition during the intrauterine period should be given to prevent early-life adverse events, which may promote insulin resistance in adulthood.

4 Therapeutic lifestyle changes should be encouraged from childhood, with strict advice of regular physical activity and restricted use of television/Internet usage. According to the recent guidelines for Asian Indians, children should undertake at least 60 min of outdoor physical activity. Screen time (television/computers) should be less than 2 h a day. Healthy lifestyle should be inculcated in children through rigorous implementation of school health programs.

5 Physicians should strictly monitor velocity of growth of children to avoid childhood obesity and ‘catch-up obesity’.

6 Bodyweight and anthropometric indexes for adults should be maintained within normal limits based on the recent data. According to recent consensus statement for Asian Indians, BMI should be maintained between 18 and 22.9, and waist circumference should be maintained below 90 cm for men and 80 cm for women [13].

7 Overweight individuals and those with abdominal obesity should be actively managed to lose weight by lifestyle measures [22, 23].

8 Detection of one component of the metabolic syndrome should lead to search for the other components and its management [13].

9 In general, a total of 60 min daily of physical activity is recommended for prevention and management of obesity and the metabolic syndrome for Asian Indians according to recently approved guidelines. This includes aerobic activity, work-related activity and muscle-strengthening activity [23].

10 Diets should be balanced containing carbohydrate (55–65% of calories) with emphasis on complex carbohydrates, restricted total fats and saturated fat (7–10% of the total calories), adequate MUFAs, ω-3 PUFAs and fiber. Trans fatty acid-containing oils and foods should be strictly avoided [22].

11 Research on insulin resistance and the metabolic syndrome in South Asians should be targeted on the following:
   a Prevalence of the metabolic syndrome in various South-Asian countries.
   b Etiological factors of insulin resistance, particularly studies on genetics and genetic-environmental interaction.
   c Associations of specific macro- and micronutrients in South Asian diet with insulin resistance (e.g. ω-3 PUFAs and dietary fiber).
d The relationship with novel cardiovascular risk factors (e.g. high-
sensitivity C-reactive protein).

e Intervention with insulin sensitizers and other drugs.

f Diagnostic criteria of the metabolic syndrome and morbidity correlation
in children.

g Effective health intervention methods of imparting lifestyle and diet-
related health messages in children.

Community Intervention Programs for Childhood Obesity in India

Community-based interventions are aimed at generating awareness and provid-
ing a conducive environment for children to follow a healthy lifestyle (balanced
diet and increased physical activity) and promote healthy food alternatives. In
India, we have initiated comprehensive programs aiming at childhood obesity,
namely CHETNA (Hindi for ‘The Awareness’; Children Health Education
through Nutrition and Health Awareness program), which was carried out in
new Delhi, and MARG (Hindi for ‘The Path’; Medical Education for Children/
Adolescents for Realistic Prevention of Obesity and Diabetes and for Healthy
Ageing), carried out in 15 cities of North India covering nearly 700,000 children.
Under these programs, children are given nutritional and physical activity edu-
cation with the help of lectures, leaflets, debates and skits. These comprehensive
programs initiated on a large scale for the first time in South Asia aimed to im-
part education regarding healthy lifestyle not only to children, but also to teach-
ers and parents. The MARG program is the first large-scale community inter-
vention project in South Asia which focuses 100% on primary prevention of not
only diabetes, but on noncommunicable diseases in general [24–32].

Disclosure Statement

The authors have no conflict of interest.

References

1 Misra A, Khurana L: Obesity and the meta-
 bolic syndrome in developing countries. J
2 Misra A, Vikram NK: Insulin resistance syn-
drome (metabolic syndrome) and obesity in
Asian Indians: evidence and implications.
3 Misra A, Khurana L, Isharwal S, Bhardwaj S:
South Asian diets and insulin resistance. Br J
4 Bedi US, Singh S, Syed A, et al: Coronary ar-
tery disease in South Asians: an emerging risk