

and community mobilisation was possible for the Mitadin programme, but there were no community-level baselines or controls in the programme design to measure outcomes, and sufficient sample sizes were neither easy nor affordable. At this stage, outcomes can be assessed only by use of indicators in independent surveys of national health and demographics. These surveys show that the rural infant mortality in Chhattisgarh decreased from 85 deaths per 1000 livebirths in 2002 to 65 deaths per 1000 livebirths in 2005,<sup>5</sup> which is much the same as the national rural infant mortality rate (64 deaths per 1000 livebirths). However, estimation of the precise contribution of the Mitadin programme to this decrease is difficult.

Much of the improvement in child survival in Chhattisgarh undoubtedly relates to better health-seeking behaviour and child-care practices. The initiation of breastfeeding in the first 2 h after birth increased from 24% of livebirths to 71% of livebirths,<sup>6</sup> and the use of oral rehydration salts in the management of diarrhoea in children younger than 3 years increased by 12% in the 2 weeks before the survey.<sup>7</sup> These two interventions substantially affect child survival,<sup>8</sup> and were highly monitored and effective Mitadin interventions. Other recorded improvements include total immunisation and antenatal care, to which Mitadins would have lent support.<sup>7</sup>

Community participation and the empowerment of women cause change.<sup>9</sup> The many Mitadins who have since entered elected office in local governance bodies, and the successful Mitadin-led community actions against deforestation, for securing of tribal livelihoods,<sup>10</sup> for early childhood-care facilities,<sup>11</sup> or against alcohol-

ism and corruption are testimonies to the so-called unintended positive outcomes. However, as the programme grows, these actions will pose new problems for the sustainability of large-scale CHW programmes, and might again lay bare the tensions between the different expectations and descriptions of the CHW.<sup>12</sup>

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I thank Mekhala Krishnamurthy and Samir Garg for their comments. I declare that I have no conflict of interest.

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## The metabolic syndrome in children and adolescents

The metabolic syndrome in adults is defined as a cluster of risk factors for cardiovascular disease and type 2 diabetes mellitus, which include abdominal obesity, dyslipidaemia, glucose intolerance, and hypertension.<sup>1,2</sup> In 2005, the International Diabetes Federation (IDF) published its definition of the metabolic syndrome in adults.<sup>2</sup> However, to date no unified definition exists to assess risk or outcomes in children and adolescents.

Early identification of children who are at risk of developing the syndrome, type 2 diabetes mellitus,

and cardiovascular disease in later life is important. Circumstances in utero and in early childhood predispose a child to disorders such as obesity, dysglycaemia, and the metabolic syndrome.<sup>3–5</sup> Furthermore, urbanisation, unhealthy diet, and sedentary lifestyle are major contributors to such disorders.<sup>1</sup> Obesity is associated with increased risk of cardiovascular disease, which may persist from childhood and adolescence into young adulthood.<sup>4,6</sup>

A clinically accessible diagnostic tool is needed to identify the metabolic syndrome in young people

globally. This need prompted the IDF to develop a new simple definition. Consistent with criteria for adults,<sup>2</sup> this definition is a starting point that can be changed as information emerges. The new IDF definition for the metabolic syndrome in young people builds on previous studies that used modified adult criteria to investigate prevalence in children and adolescents (panel).<sup>6-10</sup> Thus a study of adolescents that used modified Adult Treatment Panel III (ATP III) criteria identified 12% with metabolic syndrome.<sup>10</sup> In those aged 12-19 years in the National Health And Nutrition Examination Survey III,<sup>6</sup> which used modified ATP-III criteria, about 10% had the syndrome. A recent study<sup>11</sup> suggested a new set of criteria with age-specific and sex-specific cutoffs, which underlined the need for a consistent definition.

Many variables are used to define obesity in children. However, waist circumference in children, consistent with the situation in adults, is an independent predictor of insulin resistance, lipid levels, and blood pressure.<sup>7,12</sup> Moreover, in young people who are obese and have similar body-mass index, insulin sensitivity is lower in those with high amounts of visceral adipose tissue than in those with low amounts.<sup>12</sup> Therefore waist measurement is included in the new definition. Percentiles, rather than absolute values, of waist circumference have been used in the new definition to compensate for variation in child development and ethnic origin. Data for percentiles of waist circumference that are specific to ethnic origin are becoming increasingly available.<sup>13</sup> Children who have a waist circumference higher than the 90th percentile are more likely to have multiple risk factors for cardiovascular disease than are those with lower waist circumference.<sup>14</sup> Several studies<sup>6,7,15</sup> have used the 90th percentile as a cutoff for waist circumference. These data, and the unequivocal evidence for the dangers of abdominal obesity in adults, lend support to its use as the main and essential component of the new definition for diagnosis of the metabolic syndrome in children and adolescents. The IDF has chosen to use the 90th percentile as a cutoff for waist circumference, which will be reassessed when more data are available.

The new IDF definition is divided according to age-groups because of developmental challenges presented by age-related differences in children and adolescents: age 6 years to younger than 10 years; age 10 years to younger than 16 years; and 16 years or older. Children who are younger than 6 years were excluded

**Panel: IDF definition of at-risk group and of metabolic syndrome in children and adolescents**

**Age 6 to <10 years**

- Obesity  $\geq$ 90th percentile as assessed by waist circumference
- Metabolic syndrome cannot be diagnosed, but further measurements should be made if family history of metabolic syndrome, type 2 diabetes mellitus, dyslipidaemia, cardiovascular disease, hypertension, or obesity

**Age 10 to <16 years**

- Obesity  $\geq$ 90th percentile (or adult cutoff if lower) as assessed by waist circumference
- Triglycerides  $\geq$ 1.7 mmol/L
- HDL-cholesterol  $<$ 1.03 mmol/L
- Blood pressure  $\geq$ 130 mm Hg systolic or  $\geq$ 85 mm Hg diastolic
- Glucose  $\geq$ 5.6 mmol/L (oral glucose tolerance test recommended) or known type 2 diabetes mellitus

**Age  $>$ 16 years**

- Use existing IDF criteria for adults<sup>2</sup>

from the definition because of insufficient data for this age-group. We suggest that the metabolic syndrome should not be diagnosed in children younger than age 10 years, but that a strong message for weight reduction should be delivered for those with abdominal obesity.

For children aged 10 years or older, metabolic syndrome can be diagnosed by abdominal obesity and the presence of two or more other clinical features (ie, elevated triglycerides, low HDL-cholesterol, high blood pressure, or increased plasma glucose). Whereas one definition, albeit with cutoffs specific for sex and ethnic origin, is suitable for use in at-risk adults,<sup>2</sup> use of one definition in children and adolescents is problematic. Blood pressure, lipid levels, insulin sensitivity, and anthropometric variables change with age and pubertal development. However, in the absence of contemporary definitive data, the criteria adhere to the absolute values in the IDF adult definition, except that waist circumference percentiles are recommended and one (rather than a sex-specific) cutoff is used for HDL. For children older than 16 years, the IDF adult criteria can be used. Further research is needed to identify optimum criteria for definition of the syndrome.

Key recommendations from the IDF for future research include: understanding of the relation between body fat and its distribution in children and adolescents;

investigation of whether early growth patterns predict future adiposity and other features of the syndrome; and initiation of long-term studies of cohorts of children of different ethnic origin into adulthood to define the natural history and effectiveness of interventions, especially those relating to lifestyle.

The IDF aimed to develop a simple easy-to-apply clinical definition. Early detection followed by treatment—particularly lifestyle intervention—is vital to halt the progression of the metabolic syndrome in children and adolescents. Such action should reduce morbidity and mortality in adulthood and help keep to a minimum the global burden of cardiovascular disease and type 2 diabetes mellitus. Governments and society must be made more aware of the problems associated with obesity and the likelihood of progression to the metabolic syndrome in children and adolescents.

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The IDF Consensus workshop was convened by GA and PZ on behalf of the IDF Task Force on Epidemiology and Prevention of Diabetes, and was sponsored by an unrestricted educational grant from Sanofi-Aventis. The funding covered the cost of travel and accommodation for the meeting. The company was not represented at the meeting, and had no involvement in the writing of this Comment. Except for GW and MS, we declare consultancy, speaker fees, and/or research support from relevant drug companies; FK is a shareholder in Diabetes Prevention Services.

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