

Child and adolescent obesity in Asia

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Childhood obesity is a rapidly growing public health problem in developing countries. World Health Organization estimated that in 2010, of 43 million overweight/obese children worldwide, about 35 million of them were living in developing countries. In this chapter we will present case studies on what is happening in Vietnam, Indonesia, Thailand and China, the developing countries in the Southeast and East Asia that are undergoing rapid socioeconomic development and urbanisation. We will also explore the possibilities of what the governments and communities can do to address the emerging childhood obesity epidemic in these countries.

Although high rates of childhood obesity have been evident for some time across North America, Europe, and parts of the Western Pacific, including Australia [1], in recent years lower- and middle-income countries have joined the trend. As a result, the absolute number of children who are overweight or obese is now much higher in developing than developed countries [2]. At the end of 2010, 43 million preschool-aged children were overweight or obese – a prevalence of 6.7%, up from 4.2% in 1990 globally [3]. The World Health Organization (WHO) has declared childhood obesity ‘one of the most serious public health challenges of the 21st century’ [4]. Overweight and obesity in childhood are not simply ‘shrugged off’ in adulthood. Longitudinal studies show that when acquired early, overweight and obesity can have serious adverse effects in later life, such as metabolic and cardiovascular risks [5–7]. Importantly, obese children have a 25%–50% risk of progressing to obesity in adulthood, and this risk may be as high as 78% in obese adolescents [5].

This chapter reports on the background of a Regional Collaboration for Childhood Obesity Prevention Research program, funded by AusAID (the Australian Government’s Overseas Aid Program), with participants from China, Vietnam, Indonesia and Thailand. These countries have enjoyed rapid economic growth in recent decades (Table 1), with increased gross national income and family disposable income which are accompanied by a shift from under- to over-nutrition [8–12]. Childhood obesity has become a major public concern in these countries. In this chapter we will review prevalence and trend data from these four countries, discuss the similarities and differences, and highlight social, behavioural and environmental factors associated with the rapid growth of childhood obesity. We will also explore intervention strategies for the East and Southeast Asia region.

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Table 1. Income (GNI per capita) and level of urbanisation by country*

	Thailand	China	Indonesia	Vietnam
Income level	Upper Middle	Upper Middle	Lower Middle	Lower Middle
GNI per capita	4210 U\$	4260 U\$	2580 U\$	1100 U\$
2009 Urban population (%)	34	44	53	28

* Based on World Bank 2010 data

Definitions of child and adolescent overweight and obesity

Unlike the situation in adulthood, body mass index (BMI; weight/height²) differs, physiologically, by age, sex and development stage in children and adolescents. Thus, BMI rises in the first year, falls during preschool years, reaching its lowest point between four to seven years, before rising once more into adolescence and adulthood. Because of this, the standard definition of overweight and obesity in adulthood cannot be used when describing the paediatric population. Several different ways of defining child and adolescent overweight and obesity are commonly used (Table 2), with no one universal consensus definition having been agreed upon. Some of the currently used international definitions are described below. They are mainly based upon BMI, but have used somewhat different approaches for defining the cut-off points for healthy weight, overweight and obesity.

Table 2 Different definitions of child and adolescent overweight and obesity

	International Obesity Task Force	World Health Organization	World Health Organization	World Health Organization
	IOTF reference (Cole et al, 2000)	WHO reference (WHO 1995)	WHO reference (WHO 2006)	WHO reference (WHO 2007)
Age	2-18 y	6-19 y	0-5 y	5-19 y
Data and reference populations	Survey data from the US, Brazil, Britain, Hong Kong, Singapore and the Netherlands	US NHANES I data based on NCHS 1977 reference	Data from Brazil, Ghana, India, Norway, Oman, and the US	US NHANES I data based on NCHS 1977 reference + < 5 child growth standards samples
Overweight	BMI-for-age cut-offs derived from BMI – age curves passed BMI of 25 at age 18	BMI 85th percentile	BMI > =+ 2SD	BMI > =+ 1SD
Obesity	BMI-for-age cut-offs derived from BMI – age curves passed BMI of 30 at age 18	BMI 95th percentile	BMI > =+ 3SD	BMI > =+ 2SD

The International Obesity Task Force definition

The International Obesity Task Force (IOTF) has recommended BMI cut offs-based on the centile curves that at age 18 pass through the adult cut-off points of 25 kg/m² and 30 kg/m² to define overweight and obesity among children and adolescents. In 2000, Cole and his colleagues, on behalf of the IOTF, published a table of age- and sex-specific cut-off points based upon a compilation of nationally representative cross-sectional growth studies from six countries – Brazil, UK, Hong Kong, the Netherlands, Singapore, and the US [13]. These cut-off points are useful in epidemiological research to classify overweight and obesity and for international comparison of trends in overweight and obesity. This IOTF definition also provides continuity between the childhood and adulthood definitions of overweight and obesity.

The World Health Organization reference

In 1995 a WHO Expert Committee recommended that the sex- and age-specific BMI 85th and 95th percentiles in the BMI for age reference charts developed by Must et al. [14] be used to define overweight and obesity for adolescents aged ten to 19 years, and that obesity in children aged less than ten years be defined as weight-for-height z-score >2 [15]. This definition has now been superseded, although published papers may refer to it.

The WHO Child Growth Standard and the WHO growth reference for school-aged children and adolescents

The WHO has subsequently recommended two other approaches to defining overweight and obesity in the paediatric population, depending upon the age of the child. For children aged from birth to 59 months, the new WHO Child Growth Standard for children [16] is based on the WHO Multicentre Growth Reference Study which looked at the growth of healthy children from Brazil, Ghana, India, Norway, Oman, and the US. Overweight and obesity are defined as the proportion of children with BMI-for-age values >2 standard deviations (SDs) and greater than 3 SDs, respectively, from the WHO Child Growth Standard median [17].

For five- to 19-year-olds, the WHO growth reference (2007) is a reconstruction of the 1977 National Center for Health Statistics/WHO reference [18, 19]. Overweight, obesity and severe obesity are defined as the proportion of children with BMI-for-age values >1 SDs, >2 SDs and >3 SDs respectively, from the World Health Organization Growth Reference median [19].

Thus, there remains considerable variation in the approaches to defining overweight and obesity in the paediatric age group. And, as you will see below, other definitions are also being used in individual countries. This highlights the importance of knowing what definition is being used, especially if comparisons are made between different countries or different studies. Importantly, when looking at trends over time, then it is important to use the same definition at the different time points.

What's happening? Childhood obesity situation by country

Thailand: childhood obesity prevalence and trends

There have been two nationally representative surveys for obesity in children aged two to 12 years in Thailand, the Second National Health Examination Survey in 1997 and the National Child Health Survey in 2001 [20]. Over these four years, there was a substantial rise in obesity prevalence, as defined using the Thai growth reference (developed in 1995 and based on weight-for-height percentile) [21]. Obesity prevalence in preschool-aged children (two to five years) increased from 5.8% in 1997 to 7.9% in 2001. It increased to a lesser degree in children aged six to 12 years: from 5.8% to 6.7% [20]. Obesity was much more prevalent in children living in urban areas.

A recent nationwide survey involving 47 389 grade six primary school children in urban settings found that 16.7% children were overweight or obese [21]. The results were echoed by a study of preschool-aged children (four to six years) in central Thailand. Using the Thai growth reference, the prevalence of overweight (defined as BMI between the 90th and 97th percentile) was 16.1% in the urban group and 8.7% in rural group, and the prevalence of obesity (BMI greater than the 97th percentile) was 22.7% in the urban group compared with 7.4% in the rural group [22].

The prevalence of childhood obesity appears to be relative to the level of development of the region. For example, the prevalence of childhood overweight (defined this time as weight-for-height z-score greater than 2 SDs) in seven- to nine-year-old school children in Knon Kaen Municipality, in northeast Thailand, was 10.8% [23], compared with 15.6% in children (six to 12 years old; this time defined as BMI >85th percentile for age and sex) from Hat Yai, in southern Thailand, an economically advanced metropolitan region [24]. It is noticeable, however, that different references were applied in these studies, and hence direct comparisons cannot be made.

In a five-year follow-up study tracking overweight from childhood to adolescence in Hat Yai, Mo-Suwan et al. [25] found that children who were overweight in childhood were more likely to be overweight as adolescents. Overall 11.8% children remained overweight, with a higher proportion of boys (13.9%) than girls (10.1%).

Social, behavioural and environmental factors associated with childhood obesity

Several studies have examined the social determinants of childhood obesity in Thailand. Socioeconomic status (SES), as measured by parents' education levels and monthly household income levels, are positively associated with increased risk [22, 25, 26]. Thus, children of parents with high education levels or high household incomes are more likely to have a high BMI. Other factors such as a high BMI for father or mother, a family history of obesity and physically inactivity are also associated with increased child BMI [25].

China: childhood obesity prevalence and trends

School-aged children and adolescents

In China, there are two nationally representative data collection systems. The China National Survey on Students' Constitution and Health (CNSSCH) is a national initiative by the Ministries of Education, Health, Science and Technology, State National Affairs and State Sports Administration. It started in 1985 and is repeated every five years for school-aged children and adolescents (aged seven to 18 years). The available data from the 1985, 1995, 2000 and 2005 surveys show that the prevalence of overweight and obesity (using the Group of China Obesity Task Force definition, BMI 85th to 95th and BMI greater than 95th percentile) [27] has steadily increased from 1985. The changes were particularly remarkable in seven- to 12-year-old boys from urban settings, with the prevalence of overweight increasing dramatically from 1.7% to 25%, and that of obesity from 0.1% to 11.7%, between 1985 and 2005 [28]. A geographic gradient has also emerged from the CNSSCH data. The prevalence of overweight and obesity is highest in children from the most advanced metropolitan centres such as Beijing and Shanghai and other coastal large cities, followed by the medium/small coastal cities, then the inland big cities, and finally the medium/small inland cities [29]. This suggests that the childhood obesity epidemic in China is largely driven by economic and social development, and it is still at its early stage. The China National Nutrition and Health Surveys (CNNHS) have been carried out every ten years since 1982. The 1982, 1992 and 2002 data (analysed using the IOTF definition for obesity) for school-aged children (aged seven to 17 years) revealed very similar results to the CNSSCH. The prevalence of childhood obesity was low in early 1980, but there was a threefold increase over the subsequent 20 years [30].

The China Health and Nutrition Survey (CHNS) is a longitudinal subnational study carried out in nine provinces in the eastern part of China since 1991 with the most recent data being from 2006. The trend data show that the mean BMI of seven- to 17-year-old Chinese children and adolescents has increased steadily from 17.4 kg/m² (95% CI: 17.3, 17.5) in 1991 to 18.3 kg/m² (95% CI: 18.1, 18.5) in 2006, after adjusting for age, sex and urban/rural residence. There was a corresponding increase in overweight and obesity prevalence (IOTF definition) during the same period, from 5.2% to 13.2% [31]. The results from this dataset were higher than those obtained from the CNNHS, despite the same reference cut-off points being used. One of the explanations is that this is not a nationally representative sample, and that the economic development in the provinces in the eastern part of China sampled is relatively advanced.

A number of provincial and municipal levels studies have also shown similar patterns. Based on analysis of the CNSSCH data, the overall prevalence of overweight and obesity in seven- to 18-year-olds from Shandong Province, in eastern China, increased from 2.2% in 1985 to 31.2% in 2010 for boys and from 2.3% to 19.1% for girls, using the Chinese weight-for-height criteria [32]. In a cross-sectional survey conducted in 2004 [33] among 1800 junior high school students (aged 11 to 17 years) in Xi'an Metropolitan area, in northwest China, the overall overweight and obesity prevalence (using the IOTF definition) was

16.3%, with a significant sex difference: 19.4% for boys and 13.2% for girls. The prevalence was higher in children living in urban area and from rich families.

Preschool-aged children (under seven years)

Although there are no national representative data for assessing childhood obesity in younger children, the nine cities epidemiological surveys, carried out by the Coordinating Group of Nine Cities Study on the Physical Growth and Development of Children in 1986, 1996 and 2006, provide trend data on children under seven years of age [34]. The nine cities are Beijing, Harbin and Xi'an in the north, Shanghai, Nanjing and Wuhan in the central region and Guangzhou, Fuzhou and Kunming in the south. The 2006 survey included 112 945 children. Using the National Centre for Health Statistics/WHO reference (weight-for-height >10% and >20%), the overall prevalence of overweight and obesity was 6.3% (6.6% for boys and 5.9% for girls) and 3.2% (3.8% for boys and 2.5% for girls) respectively [34]. Compared with the 1986 results, the prevalence of overweight nearly tripled in 20 years, with an average annual increase of 6.9% [34].

Another subnational survey began in 1986 in children aged zero to six years covering 11 cities in the east, central and southern regions. There have been two subsequent surveys with a ten-year interval. The most recent survey was in 2006, with total sample size of 84 766 [35]. The prevalence of overweight and obesity (WHO Child Growth Standard; BMI greater than 1 SD and greater than 2 SD) was 19.8% (22.2% for boys and 17% for girls) and 7.2% (9.9% for boys and 5.3% for girls), respectively. Due to the different definitions used, the data for similar age groups in the two 2006 surveys are not comparable. In fact, there was a threefold difference for the overweight prevalence and more than twofold difference for obesity prevalence. Nevertheless, both surveys have consistently shown that overweight and obesity prevalence is higher in boys than in girls.

A similar sex difference was found in Shanghai; the obesity rate (National Centre for Health Statistics /WHO reference, with weight-for-height greater than 20%) in 5188 kindergarten children (aged from three to six years) was 8.3%, with 10.3% for boys and 7.1% for girls [36].

In a large sample study involving 262 738 preschool children (aged from 3.5 to 6.4 years) in three provinces (Hebei in the north, Zhejiang and Jiangsu in the south), the overall prevalence of overweight and obesity (IOTF definition) was 7.4% [37]. However, unlike the findings in the two large scale subnational surveys described above, the prevalence of overweight/obesity was higher for girls (7.8%, 95% CI: 7.1, 8.0) than for boys (6.9%, 95% CI: 6.8, 7.1). An interesting finding from this survey is that the children residing in rural areas, both north and south, had a relatively higher risk of being overweight/obese compared with children from urban settings in the south (adjusted relative risk = 2.58, 95% CI: 2.43, 2.73; and relative risk = 1.15, 95% CI: 1.09, 1.21; respectively). The possible explanations of the difference of the prevalence of overweight/obesity between children from rural areas of north and south include differences in genetic factors and dietary habits. Furthermore, Zhejiang and Jiangsu are two of the most developed coastal provinces. The small difference in overweight/obese prevalence between rural and urban children from the south may be

attributed to the narrowing gap of living standards and lifestyle between rural and urban population in the more economically advanced areas in China.

Social, behavioural and environmental factors associated with childhood obesity

In general, due to the disparities in economic and social development, childhood obesity prevalence is higher in urban than rural settings [28, 29, 38]. A study from Xi'an reported that adolescents from wealthier families, or whose parents were overweight or obese, or those who had permission to purchase snacks with pocket money, were 1.7, 1.8 and 1.5 times more likely to be overweight/obese, respectively, than their counterparts [38]. Risk factors identified in boys included consuming sweetened soft drink four or more times/week (odds ratio [OR] = 1.6) or more than 1100 ml/day (OR = 1.9) and higher levels of energy consumption (medium to high-energy intake OR = 1.5 and 1.9, respectively) [38, 39]. Interestingly, having a mother with tertiary education was associated with a higher prevalence of overweight/obesity in boys (OR = 2.2) but not in girls [38]. Having breakfast outside the family home was a stronger dietary risk factor in girls only (OR = 1.7, 95% CI 1.1–2.3) [39].

In the 2004 study on obesity and metabolic syndrome among 21 198 children (two to 18-year-old) in Beijing [40], obesity (after adjustment for age, sex, puberty and residential area) was significantly associated with a range of factors. These include: being physically inactive (less than one hour/day physical activity, including physical education class, physical activities after school, walking or bike riding to and from school), spending two or more hours per day watching TV, on the computer or playing video games, snacking frequently (three or more times/week), consuming Western fast foods or having reduced hours of sleep (<10 hours for six- to 12-year-olds and <8.5 hours for 13- to 18-year-olds). However, there was no significant association between obesity and consumption of sweetened beverage [40].

The reported risk factors from the nine cities epidemiological survey and other studies for obesity in preschool-aged children (birth to seven years) included having a good appetite and fast eating [34], high parental BMI or parental overweight [34, 41], maternal overweight [41], watching more than two hours a day of TV [34, 41], lower maternal education level [41, 42] and a lower paternal education level [42]. In infants and young children (aged one to 35 months), a higher total energy intake, formula feeding in the first four months and introduction to semi-solids before four months of age were significantly associated with overweight [42]. Other factors such as caesarean section birth [34], birth weight more than 3000 grams [43], sleeping less than 11 hours/night [44] were associated with overweight or obesity in children in this age group.

Indonesia: childhood obesity prevalence and trends

Data from the National Basic Health Research in 2007 showed that overnutrition existed among all age groups in Indonesia [12]. In children under five years, 12% were overweight (WHO Child Growth Standard BMI >2 SD), which was very close to the prevalence of undernutrition in the same age group (14 %, WHO weight-for-height less than -2 SD). In

six to 14-year-olds, the prevalence of obesity (WHO Growth Reference BMI greater than 2 SD) was 10% and 6% for boys and girls, respectively. In the 15 years and above age group, the combined overweight and obesity (defined as BMI between 25 to 27 kg/m² and >27 kg/m² respectively) was 19%. As found in other countries, in the six- to 14-year-old age group, the prevalence of overweight was higher in children living in urban areas than in their rural counterparts: 11% for urban boys vs 9% for rural boys, and 7% for urban girls vs 6% for rural girls [12].

Although these nationally representative data were only collected recently, overweight and obesity among primary school-aged children have been documented earlier [12, 45]. In a cross-sectional study involving 3000 pre-pubertal school-aged children from Central Java, the overall prevalence of overweight was 2.7% (IOTF definition). The prevalence of overweight in the non-poor urban group was 4.9%, which was five times higher than the rural group [46]. Obesity prevalence was higher for boys than for girls, but no sex difference for overweight prevalence was found. The Yogyakarta five-year (1999 to 2004) tracking study from pre-pubertal children to adolescents found that the prevalence of overweight (US Centers for Disease Prevention and Control reference BMI 85th to 95th percentile) and obesity (BMI ≥95th percentile) increased from 4.2% and 1.9%, to 8.8% and 3.2% respectively, over this time [47]. Moreover, all obese children stayed obese over the five-year period, and 85% of the overweight children remained overweight [47].

Social, behavioural and environmental factors associated with childhood obesity

The reported factors associated with overweight and obesity from Indonesia include urban (versus rural) residence and higher family income levels, as seen in Thailand and China. Children from non-poor urban families had a higher risk of becoming overweight or obese [46].

Vietnam: childhood obesity prevalence and trends

Adolescents

Systematic national data on the prevalence of child and adolescent obesity are not available in Vietnam. The reported studies are from Ho Chi Min City (HCMC), in adolescents as well as preschool-aged children. Two recent epidemiological surveys conducted in 2002 and 2004, in junior high school students (aged from 11 to 16 years) that revealed a rapid decline in the prevalence of underweight (US Centers for Disease Prevention and Control growth reference BMI Z-score less than -2 SD) halved in just these two years. At the same time, the overall prevalence of overweight and obesity (IOTF definition) more than doubled, from 5.9% to 11.7% and from 0.7% to 2.1%, respectively [48]. The increase in prevalence of overweight and obesity was particularly marked in boys, from 7.8% (95 CI: 3.2, 17.9) and 1.2 (95% CI: 0.3, 4.0) in 2002 to 16.2% (95% CI: 13.3, 19.5) and 3.1 (95% CI: 2.2, 4.4) in 2006, especially in the younger age groups. Furthermore, the largest increase was seen in boys from wealthiest families. These findings are similar to results from the study in Xi'an, China [33].

Preschool-aged children

The 2005 cross-sectional survey of a representative sample of 670 preschool-aged children (aged from 48 to 65 months) in urban areas of HCMC [11] found a remarkably high prevalence (IOTF definition) of overweight (20.5%, 95% CI: 17.5, 24.3) and obesity (16.3%, 95% CI: 13.2, 20.4). The prevalence trend between 2002 and 2005 in preschool-aged children in HCMC are consistent with the findings for adolescents [48]. The total prevalence of overweight/obesity in preschoolers almost doubled from 2002 to 2005 (21.4%, 95% CI: 17.5, 25.8 and 36.8% 95% CI: 32.0, 41.8 respectively). The increase was greater for boys (from 22.6% to 40.8%) than for girls (from 20.4% to 32.8%) and of particular interest was the increase in the less wealthy districts: from 16.9% (95% CI: 13.3, 21.2) to 35.9% (95% CI: 29.4, 42.9) in three years [49]. However, unlike the findings reported by Hong et al. [48] for adolescents, there was no significant difference in the level of overweight/obesity for children from poor and rich families.

Social, behavioural and environmental factors associated with childhood obesity

Significant associations have been demonstrated between childhood overweight/obesity and family social status (fathers having secondary school or above education, fathers working as professionals, and mothers having government employment), both parents having a BMI ≥ 23 kg/m² [50], one or both parents being overweight [49], children being from wealthy families and having a birth weight ≥ 4000 grams [11]. Prolonged breastfeeding and longer duration of sleeping at night have a protective effect [11]. Many of these factors have also been identified in studies from Thailand and China.

Common characteristics of childhood obesity among the four Asian countries and differences from the West

The common characteristics of childhood overweight and obesity in Thailand, China, Indonesia and Vietnam include the:

- rapid increase in prevalence, especially in younger age groups
- sex difference in prevalence, highest in younger boys
- rural/urban residence differences in prevalence of overweight/obesity
- higher prevalence of overweight and obesity amongst children from households with higher economic status.

However, since the definitions used to define overweight and obesity vary from country to country, and from study to study, direct comparison of epidemiological data across countries is extremely difficult.

In contrast to what has been shown in these four Asian countries, the prevalence of childhood obesity appears to be plateauing in a number of developed countries, including Australia [51–53]. No sex differences in the prevalence of overweight/obesity in children and adolescents have been found in the UK [54], US [52] and Sweden [55]. It has been suggested that the higher prevalence in boys in Asia is at least partially related to a societal

view that favours boys over girls [48] and the traditional cultural belief that a fat child symbolise the prosperity of the family [31]. The socioeconomic gradient in relation to prevalence, including the urban/rural disparity, suggests that the childhood obesity epidemic in countries undergoing economic transition is driven by the environment and lifestyle to which the children are exposed. For instance, in urban areas of Asian countries it is common for both parents to work fulltime, having little time to prepare nutritious foods. In particular, children from higher income families tend to eat out more, including Western-style fast food, and often have pocket money to buy snacks [38]. This is a different pattern from developed countries where childhood obesity is more prevalent in lower socioeconomic status families [54, 56].

Disease consequences of childhood obesity

In adults, the cut-off values defining overweight or obesity are based on the related disease risk. There are no risk-based BMI values for children and adolescents, largely due to the time span between childhood obesity and when the adverse outcomes may occur [57]. Nevertheless, a body of evidence has shown a strong association between childhood obesity and major cardiovascular disease risk factors, such as diabetes, hypertension and metabolic syndrome (MetS) in children and adolescents. The tracking studies from Thailand and Indonesia clearly demonstrate that there is a strong tendency for overweight and obese children to remain overweight or obese into adolescence. This tendency, of course, is not confined to Asian countries [58, 59].

In a study that reviewed medical records of diabetic patients in the Division of Paediatric Endocrinology, Faculty of Medicine, Siriraj Hospital in Hat Yai, south Thailand, children and adolescents diagnosed with type 2 diabetes increased from 5% in the mid 1980 to mid 1990s to 17.9% in the late 1990s [60]. This coincided with the increase of obesity prevalence from 5.8% to 13.3% [60]. The mean age of diabetic children was 11.6 years with a mean BMI of 27.8 kg/m² [60]. In the 2006 nine cities epidemiological survey conducted in China, both the systolic (SBP) and diastolic (DBP) blood pressure of children aged three to six years were higher in obese children than in children of normal bodyweight [35]. Based on data analysis from the 2002 Chinese National Health Survey, overweight and obese adolescents (aged 15 to 17.9 years, the Group of China Obesity Task Force definition) were 3.3 and 3.9 times more likely, respectively, to have high blood pressure than their normal-weight peers, with systolic and diastolic blood pressure being about ten and five mmHg higher than in those of normal weight [61, 62]. Type 2 diabetes was found in 0.2% of seven-to 12-year-olds and 0.4% of 12-to 18-year-olds. As many as 62% of children and adolescents had dyslipidaemia or other lipid profile abnormalities [62]. Overweight was a risk factor for hyperglycaemia (OR = 2.3, 95% CI: 1.0, 5.4). More alarmingly, overweight and obesity were associated with high dyslipidaemia (OR = 1.5, 95% CI: 1.2, 1.9 and OR = 1.8, 95% CI: 1.3, 2.5 respectively), high triglyceride (OR = 1.9, 95% CI: 1.5, 2.4 and OR = 3.3, 95% CI: 2.4, 4.5 respectively), high SBP (OR = 3.4, 95% CI: 1.5, 7.5 and OR = 5.0, 95% CI: 1.5, 16.4 respectively), high DBP (OR = 2.7, 95% CI: 1.5, 4.8 and OR = 3.1, 95% CI: 1.2, 8.1 respectively) and MetS (OR = 15.4, 95% CI: 6.8, 34.8 and OR = 47.9, 95% CI: 16.0, 143.1 respectively) [62].

Two recent publications reported on survey results of MetS, using the International Diabetes Foundation definition [63], in children and adolescents from Guangzhou, China [64] and HCMC, Vietnam [65]. The overall prevalence of the metabolic syndrome in seven- to 14-year-olds from Guangzhou was 6.6%, and much higher in overweight (20.5%) and obese (33.1%) children [64]. Similarly, the metabolic syndrome was more prevalent in overweight/obese children from HCMC. Being physically active was associated with a lower odds of developing the metabolic syndrome [65]. These findings illustrate that childhood obesity poses immediate consequences to child and adolescent health.

The possibility for intervention: where to start?

Childhood obesity is a complex problem with no easy solution. The results of many intervention studies aimed at preventing obesity in school-aged children remain inconclusive due to lack of long-term follow-up [66]. Indeed, Li et al. [67] conducted a systematic review of school-based intervention studies for the prevention or reduction of excess weight gain among Chinese children and adolescents and found that most of the published studies (lasting between ten weeks to three years) were uni-dimensional, mostly focusing on improving knowledge, physical activity levels and/or diet. None of the trials demonstrated convincing efficacy. In 2009 WHO published a systematic review, 'Interventions on diet and physical activity: what works?' [68], which examined close to 400 publications between 1995 and 2005. The authors showed that multi-component interventions involving the family, school, community and government, and interventions that are adapted to the local context were the most successful [68–70]. Unfortunately, the representation of studies from low-middle income countries in the WHO review was extremely low (less than 13%). This highlights the urgent need for well-designed intervention programs to be implemented in low and middle-income countries. In the meantime, the extent to which examples of successful programs for reducing childhood obesity in developed countries could be adapted to the context of low- and middle-income countries, should be explored.

At the national level, Singapore's experience can provide some insight into national intervention programs within an Asian country that shares a similar social and cultural background and dietary patterns. Although the prevalence of childhood obesity in Singapore was not as high as in the countries described in this chapter, concerns about obesity-related morbidities had prompted the government to introduce national health promotion and disease prevention policies and programs from the early 1990s [71]. Specific policies and programs were developed for populations in different settings, including schools, communities and workplaces. Several programs were targeted at school-aged children. The Trim and Fit program was one of the longest running programs (1992 to 2006), and aimed to reduce obesity prevalence and to increase children's fitness level. Although the program achieved its overall goals, it also raised concerns about the extra pressure that overweight and obese students were subjected to, as well as stigmatisation towards them, as a result of the way in which that particular program was implemented. The program was terminated in 2006 and replaced by the Holistic Health Framework program [72]. The important point here is that nationwide programs in Singapore were implemented by government in order to prevent and control overweight and obesity in the population, in a similar manner to

national strategies for controlling communicable diseases [71]. The Thai government has recently endorsed its national obesity prevention plan. This nationwide approach to the problem is a step in the right direction.

At the community level, one successful Australian example of an obesity prevention program is the Romp & Chomp project. This four-year obesity demonstration program was targeted towards preschool children aged less than five years, and their families, in two communities in Victoria [69]. It was designed, planned and implemented as a partnership by a range of government and non-government organisations [73]. The intervention led to a significantly lower intake, by children, of packed snacks and sweet drinks, as well as a significantly higher frequency of vegetable intake. An evaluation of early childhood environments undertaken as part of this study found that no sweet drinks were being offered in any of the early childhood settings. Healthy eating policies and healthy food guidelines were implemented, and there was an increase in the availability of nutrition and physical activity resources [73]. This project demonstrated that a whole-community and settings-based approach can create environments for young children that are less obesogenic and that promote healthy weight from early age. More importantly, it shows that actions can be taken to prevent childhood obesity.

Challenges and opportunities

There are a number of challenges and opportunities in addressing the rising prevalence of overweight and obesity among children and adolescents in Asia.

1. There is an important need to gather quality nationally representative epidemiological data in all countries in order to monitor trends over time and to inform decision-making in policy development and intervention programs. Currently, China has national data collection systems in place; while Thailand and Indonesia have collected nationally representative data through the Thai National Child Health Survey (2001) and the Indonesian Basic Health Research (2007); Vietnam has the national child nutrition surveillance program, which is still orientated towards the surveillance of under-nutrition in children aged <5 years. The challenge is to achieve a robust national data collection system that can monitor the trends regularly and consistently.
2. It is important to determine the applicability of the international definitions of overweight and obesity for Asian children and adolescents. Work is under way to collate and analyse childhood obesity epidemiological data from the four countries. The data and the national growth references (Thailand and China) will be evaluated against the WHO Child Growth Standards and the WHO Growth Reference for five to 19-year-olds, as well as the IOTF definition.
3. One of the biggest challenges is to determine the value of the current definitions of childhood overweight and obesity in predicting disease risks. This will need a monitoring system to track the development of non-communicable diseases from childhood right into adolescence and adulthood.
4. Because countries in the region are facing similar issues, a regional approach to prevention may be warranted. One of the opportunities for research collaboration is

to gain a better understanding of the causative factors of childhood obesity in Asian countries. We have already identified the role of food and beverage marketing targeted at children as a research priority.

5. Evidence of effective intervention strategies and programs in countries undergoing economic and nutrition transition is urgently needed. Further research is needed to evaluate obesity prevention interventions in different age groups and settings in transition countries. These interventions will need to address the risk factors found in these countries.

Conclusion

As illustrated by data from Thailand, China, Indonesia and Vietnam, the childhood obesity epidemic in transition nations shows no signs of slowing down. Although undergoing rapid economic growth these countries share with more developed countries some common social, behavioural and environmental factors that are associated with a higher prevalence of childhood overweight and obesity. There are also characteristics that are unique to the region, such as higher rates of obesity in boys from wealthier families. It is important, therefore, to develop policies and intervention programs that are culturally appropriate to prevent and reduce rates of childhood obesity for the region.

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