

Childhood Obesity in Developing Countries

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INTRODUCTION

Childhood obesity is recognised as a global epidemic. Children in developed or industrialised countries, such as the United Kingdom, currently demonstrate high levels of obesity and overweight. The most recent estimates in 2001 suggest 15% of UK 15 year olds are obese with a further 20% overweight and in danger of becoming obese in the near future. The UK lags some 10 years behind the United States in this regard in which almost 26% of children and adolescents are reported as being obese (Wang et al., 2002).

Concern about childhood obesity is not simply aesthetic. The fact that obesity acquired during growth is detrimental to the health and well being of affected children is no longer a cause for debate. Metabolic defects in obese adults, such as peripheral and hepatic insulin resistance, can be detected in obese children (Hoffman and Armstrong, 1996). Nine-year-old obese children have greater blood pressure and plasma cholesterol than non-obese controls and obese adolescents have an increased prevalence of hypertension, sleep-disordered breathing, and orthopaedic disorders of the hips and knees (Garrow, 1999; McMurray et al., 1995; Lusky et al., 1996). In addition, Stunkard and Burt (1967) and Dietz (1992) emphasise the psychosocial consequences of obesity which are evident, for instance, in the reports of social isolation and peer problems amongst adolescents, and dissatisfaction with body shape amongst 9-year-olds (Hill, 1994). Gortmaker et al. (1993) report that overweight adolescent girls have lower educational attainment, lower incomes as young adults, and are less likely to marry than those of normal weight. All of these studies emphasise the detrimental effect of obesity on child health and well being and thus on the need to understand how such obesity is acquired (Cameron and Demerath, 2001).

The energy balance equation dictates that obesity is the result of positive energy balance in which intake exceeds expenditure. In industrialised or developed countries the increase in childhood obesity is blamed on both increased access to cheap high fat, high-energy foods and a simultaneous reduction in physical activity. Thus obesity is often viewed as a disease of development or wealth. However, the associa-

tions between obesity and the variety of other factors known to be associated with it such as ethnicity, socioeconomic status, age and gender are complex and only now being elucidated. For instance, in industrialised countries it tends to be adults of lower socioeconomic status who tend to be overweight or obese whilst in societies in economic transition or in emerging economies it is often the wealthy who display greater prevalences of obesity. Childhood presents even more complex associations because energy intake is required to be high to allow for normal growth and development. However the economic status of the country in which children resides appears to have a direct bearing on the prevalence of obesity and indeed on the curious combination of phenotypes of undernutrition with phenotypes of overnutrition. Popkin (1996) was the first to highlight that the prevalence of childhood obesity in some countries was greater in children who were stunted. Those countries (Russia, China, Brazil, South Africa) were each said to be transitional economies in which increasing wealth was being accompanied by increasing exposure to new dietary habits.

Human growth and development, and the acquisition of obesity, do not take place in a biological vacuum, but within an environmental context that mediates genetic potential. The term “developing” implies a beneficial movement from one state to another, such as from immaturity to maturity, from poverty to wealth, and from sickness to health. Recognising that high prevalences of obesity exist in developed countries and low prevalences in developing countries, we might expect that a study of development would also allow us to identify increasing risk factors for childhood obesity. However, it is important to understand that the interaction of major developing factors such as Gross National or Domestic Product (GNP, GDP), Infant Mortality Rate (IMR) and the percentage of literacy in women do not exist in isolation. Susan Hunter demonstrated in the late 1980s that such variables do not exist as independent variables but as *inter-dependent* variables that can interact in different and complex ways depending on the national level of development (Hunter, 1990). Thus an equally increasing GDP in two developing countries will not necessarily be followed by effects of equal magnitude in terms of an increasing percentage of literate

women and a decreasing IMR. In other words, providing financial support through Aid Agencies for two different developing countries will not have the same result in terms of alleviating morbidity and mortality. Similarly, the complexity of the associations between the factors that promote obesity may change depending on the level of development within which they operate.

Firstly, however, let us understand what physical context we are discussing and the way in which children grow and develop within this context. The post-Second World War nations were divided into those of the capitalist “western bloc”, i.e., the British, Americans and their allies, as the *First World*, the socialist “eastern bloc”, i.e., Russia and her satellite countries and North Korea, as the *Second World*, and the remaining nations of the world as the *Third World*. The division was thus on the principle of economic philosophy and world influence rather than on a socio-developmental scale. The French economist Alfred Sauvy is usually credited (Worsley, 1984) as the first to popularise the term “Third World”. In an article for “L’Observateur” entitled “Trois monde, une planète.”. Sauvy described the Third World as being “...ignoré, exploité, méprisé, comme le tiers état...” (Worsley, 1984, p. 307). Debray (1974) writes of the use of the term, seemingly through gritted teeth, as “...a lumbar room of a term, a shapeless bag in which we jumble together... nations, classes, races, civilisations and continents... The term “Third World” indicates a certain backwardness in economic and social development [but] the real meaning of the “Third World” is that it presents the concept of a world apart, equidistant from the capitalist First World and socialist Second World, whose sole inner determining principle is that of underdevelopment.”.

The term “underdevelopment”, and thus the concept of a developmental or changing status, arose from the first official use of the term by the United Nations in 1951. Objections by various countries followed this description because they asserted that they *were* developing or, indeed, that they *had* developed but in a different way to the West. To placate this opposition a variety of other descriptive terms were used such as “less developed”, “developing” and “late developing”. Eventually, the United Nations began classifying countries into three categories; “economically developed countries”, “centrally planned economies” and “primary producing countries”. The use of the terms “First” and “Third World” has largely fallen into disuse, especially amongst human scientists who tend to use the terms “developed” and “developing” countries. The

latter is, of course, a functional, almost dynamic description and indicates that “developing” countries are not static in the criteria used to differentiate between categories of development. But what are these criteria and how may they be used to reflect the characteristics that we expect to see in a “developing” country?

At the start of the 1990s 33% or 1.8 billion of the world’s 5.4 billion people, were children less than 16 years of age, and 33%, or 600 million of these, were less than 5 years of age. 83%, or 1.5 billion, of the world’s children lived in “developing” countries. Thus factors which affect them affect the *majority* of the world’s children. The growth characteristics of these children are the growth characteristics of the *majority* of the world’s children.

If we take a GDP of less than \$10,000 as an economic cut-off level to distinguish developed from developing countries then developing countries are to be found in both the southern and northern hemispheres and are to be found in the “east” and in the “west”. They make up all the countries of the African continent and the sub-Continents of South America, and India, and almost the entire Asian continent. The annual UN/ UNESCO publication on “The State of the World’s Children” (UNICEF, 1992) lists data on 145 countries of which only 30 (21%) are classified as “industrialised” or “developed”. Thus in absolute terms the characteristics of developed countries are as extreme at one end of the distribution as the characteristics of the least developed countries at the other end.

Developing countries present as largely impoverished countries with one-tenth of the GNP of developed countries and high rates of infant mortality, female illiteracy, and short life expectancy. A comparison of two specific countries (UK versus South Africa) will illustrate the point more clearly. In particular the differences in the percentage of children (21% for the UK versus 45% for South Africa) and the level of urbanisation (92% for the UK versus 56% for South Africa). The differences are dramatic, and indicate that *development* centres around changes in financial wealth and stability, the movement towards an industrial, non-agricultural economy, and dramatic changes in population demographics and health.

GROWTH PATTERNS IN DEVELOPING COUNTRIES

What then of the growth and development of children in such countries? (Fig. 1). Children are

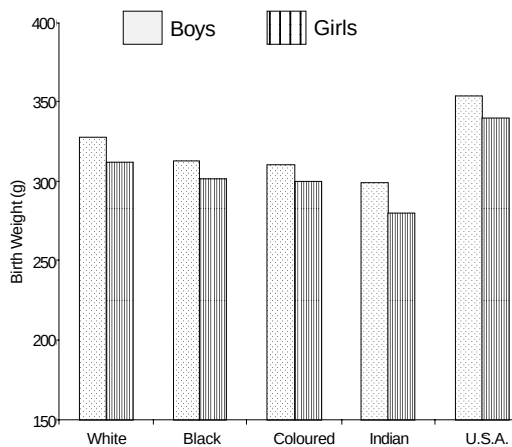


Fig. 1. Birthweights of South African children

generally born small in comparison to developed countries with mean birthweights around 3.0kg compared to the 3.4-3.7kg range of developed countries. Data from South Africa on birthweights in 1990 in the Johannesburg-Soweto metropole compared to similar data from the USA demonstrates two things. Firstly, mean birthweights are universally low when compared to those of a developed/industrialised country and secondly ethnic differences in birthweight tend not to follow socioeconomic differences. Whilst the apartheid system in South Africa actively discriminated against Indian, Coloured, and Black people in a strict hierarchical order the birthweight order is, from heaviest to lightest, Black, Coloured, and Indian. The explanation for this apparent anomaly lies in the over-riding influence of maternal size on birthweight. Indian mothers tend to be smaller and lighter than mothers of other nationalities and thus produce smaller babies.

During the first 2 to 3 years of life the effect of an impoverished environment has an increasing impact on the growth of children such that 20% to 30% are stunted by 2 to 3 years of age. Some degree of canalisation occurs between 5 and 10 years of age corresponding to the 10th to 25th centiles of NCHS references for both height and weight. The adolescent growth spurt is characterised by low pre peak velocities but high and extended post-peak velocities that result in some degree of "compensatory" growth. (To describe such growth as "catch-up growth" would be to imply that we are aware that whatever was stressing the child and constraining his or her growth prior to adolescence has been removed. We have no evidence that this is so and thus we use the term "compensatory" to describe such a growth

pattern.) Growth continues until the early 20s with the result that adult heights and weights are greater than would be expected from pre-adolescent centile positions with the majority of adult mean heights and weights falling within the NCHS references between the 10th and 50th centiles. Mean weights demonstrate similar trends with the result that weight-for-height and other measures of weight/height ratio, such as BMI, tend to be close to the 50th centile of American references although in Africa at least there is a clear tendency for women to exhibit greater weight-for-height than men.

The major characteristics of the growth pattern of children in developing countries are thus relatively low birthweights followed by failure to thrive in the first two years leading to stunting during infancy. By the age of school entry, typically 5 to 6 years, mean heights and weights are between the 5th and 10th centiles of NCHS references. This diminished height and weight status is accompanied by subcutaneous fat measures that are also well below the average for developed countries. Adolescence heralds delayed puberty and an extended growth spurt so that adult heights and weights are not reached until the early 20s but are better than would be expected, lying between the 10th and 50th centiles.

The environmental correlates to this growth pattern are that the child born into the developing world has a 65% chance of being born into an environment in which no medically qualified help is available. A traditional birth attendant may well be present but the place of birth would, in all probability, be the home. Only 30% of the mothers of such children would be literate and thus be equipped to take advantage of the knowledge surrounding childbirth and care. But the child would have many peer group companions. Almost 50% of the population of his/her country would be children under the age of 16 years. However, many of these colleagues would be lost in the first five years of life; over 10% in the first year, and almost 20% by the time the survivor reached five years of age. Money and food would always be in short supply. GNP per capita would be 5% of that available to the child in the developed world and inflation nearer 30%. The child could only expect to live for 50 years and consume two-thirds of the calories available to his/her companion in the developed world.

It is curious then that against this background of poverty, economic hardship, lack of access to health care, and low calorie supply we can also discuss the prevalence of obesity in the developing world.

THE PREVALENCE OF OBESITY IN DEVELOPING COUNTRIES

William Dietz (1994) defined four critical periods for the development of obesity in childhood. The intrauterine period, infancy, adipose rebound between 5 and 7 years, and adolescence. It is interesting that these coincide with critical landmarks on the growth curve and periods of increased growth velocity. The pre-natal period coincides with period of absolutely maximum growth velocity in height between 20 and 30 post-LMP weeks and in weight between 30 and 40 post-LMP weeks. Whilst growth velocity is decelerating after birth it is still most rapid during infancy and then again in two further spurts; the mid-growth or juvenile spurt at 6 to 8 years of age and the adolescent growth spurt from 10 years onwards.

Given the pattern of growth of children in developing countries, and the environment within which growth takes place, it would seem unusual for obesity, as defined by either a high BMI or high subcutaneous fat levels, to be a major problem. Relatively low mean heights and weights, with similar variance to samples from developed countries, suggest that obesity via BMI, is not a problem in developing countries although the peoples of the islands of the Pacific and Indian Oceans would appear to be exceptions to this rule. Dowse et al. (1996) whilst noting adult obesity prevalences ranging from 70% in Nauruans and urban Western Samoans to a modest 15% amongst the Indian inhabitants of Mauritius, believed the cause to be the Neel's "thrifty genotype" acting in the presence of a non-traditional lifestyle characterised by the diet and physical activity levels of developed countries. In other words high prevalences of obesity were accompanied by the process of "westernisation" or "modernisation". Whilst little mention is made of the children of these populations, it seems unlikely that the obese adults had not been obese children and adolescents and indeed the "most dramatic gains" in BMI amongst the Nauruans had been identified in the 1970s and 1980s as being in children and youths. It is significant that in all data it is females who have higher prevalences of obesity than males.

Female obesity was also the focus of our recent South African research that sought to find an answer to some aspects of obesity amongst African children and adolescents. Walker and Segal (1980) described "the puzzle" of African obesity in the early 1980s. Such obesity is common amongst women, rare amongst men and

mostly benign in that it had no significant prejudicial effect on serum HDL cholesterol, triglycerides or uric acid. It had no effect on glucose tolerance and it was not accompanied by increasing blood pressure.

Children from a longitudinal growth study carried out in the traditional rural area of Ubombo, just south of the Mozambique border, were used to investigate prevalences of obesity according to BMIs greater than the NHANES 85th centile. Whilst little or no obesity was observed in boys, girls tended to have two periods of increased prevalence coinciding with the mid-growth spurt and the latter part of the adolescent growth spurt. The adolescent gain was most dramatic and occurred neither at the start of the adolescent growth spurt, nor coincident with peak velocity, but following menarche. This led us to the conclusion that the hormonal changes associated with the initiation of the menstrual cycle were highly significant in promoting the retention of fat (Cameron and Getz, 1997).

Such prevalences are, however, relatively rare in traditional rural societies and it is by far the more common situation for obesity to manifest as part of the process of "westernisation" or "modernisation" which has at its core the movement of people from rural agricultural areas to urban industrial centres. This transition is accompanied by the adoption of lifestyles that are characterised by major changes in diet and physical activity.

STUNTING AND OBESITY

One such area of risk concerns children who are born small and who are then exposed to an abundant high fat diet. Children born small in developing countries, such as South Africa, are at risk of stunting during infancy. Stunting, defined as z-score of height-for-age against WHO/NCHS references of less than -2, is regarded as a *persistent* consequence of inadequate health and nutrition during infancy (Martorell, 1992). This belief in the persistence of stunting is primarily based on follow-up data of 249 Guatemalan children (120 males) measured at 3 and again at 18 years of age or older. These subjects demonstrated significant stunting at 3 years of age when only 38 males (31.7%) and 26 females (20.2%) exhibited heights greater than -2 Z-scores. After controlling for the age at which the adult measurement took place significant positive standard regression coefficients were found between length at 3 and adult height but no relationship was found between length at 3 years and height

increment from 3 years to adulthood. The authors concluded that, "...length at 3 years of age is independent of linear growth from 3 years to adulthood. The growth retardation incurred in early childhood, therefore, is not recuperated later (e.g. catch-up growth would result in a significant, negative relationship)." Relatively small but statistically significant associations were also found between height at 3 years and functional variables (Pollitt, 1995) such as right grip-strength ($b=0.40$ males; $b=0.38$ females), school achievement (0.19; 0.19), non-verbal intelligence in males (Raven test) (0.31), literacy (0.33; 0.35), numeracy (0.20; 0.19), and general knowledge (0.23; 0.27). The statistical significance of these relationships was taken as a clear demonstration that growth retardation in early childhood is associated with significant functional impairment in adulthood. Naturally these findings were of major importance, not just in identifying infancy as a time when the conditions that lead to stunting are to be avoided, but in highlighting the fact that if such conditions were not avoided then the resulting loss of stature was associated with significant long-term detrimental consequences.

Recent research has linked stunting in infancy and childhood with obesity. Popkin et al. (1996) analysed data from four countries experiencing economic and nutritional transition; Russia, China, Brazil, and South Africa. The 1994 South African data from the Living Standards Measurement Survey was a multistage random sample of 848 households involving 43974 individuals. Whilst 30.6% were stunted by three to six years of age and only 7.5% were overweight or obese, 13% were *both* stunted and obese compared to 5% who were not stunted and obese. The linking of "obesity" with "stunting" appears, at first sight, to be something of a misnomer because they are contradictory elements whether they exist in a developed or developing country. Obesity is associated with an overabundance of the factors that promote high weight gains and that result in a high weight-for-age and a high weight-for-height. It is not generally associated with chronically poor environmental conditions of the type that are associated with a high prevalence of stunting. Overweight is usually defined as body mass index (BMI) greater than 25 and obesity as a BMI equal to or greater than 30. Stunting is associated with chronic environmental insult usually affecting the infant and manifesting at between 2 and 3 years of age. So why and how do these two apparently disparate concepts become linked?

The nutritional importance of the prenatal

period has largely been investigated through the follow-up studies of children born during periods of famine. The most famous of these is the "Dutch Hunger Winter" beginning in October 1944 when food supply to Dutch cities was dramatically reduced by the German occupation of the western Netherlands. At the beginning of the occupation the average per capita daily ration approximated 7533 kJ (1800 kcal/day) and declined to 2511 kJ (600 kcal/day) in the following 6 months. In May 1945, after liberation, the daily ration increased to 7114 kJ (1700 kcal/day). Because the time limits of this famine were so well documented investigations of the affect of maternal nutrition on foetal and infant growth and wellbeing could be accurately assessed. Ravelli, Stein and Susser (1976) published an analysis of the growth and physical status of 19 year old Dutch military conscripts who had been exposed to famine in utero or in the perinatal period compared with age-matched controls from areas of Holland that had not been exposed to famine. The prevalence of obesity amongst men exposed to famine in the first two trimesters was dramatically increased compared to those exposed to famine in the third trimester or postnatally.

Strength was added to this relationship by the work of Barker and his colleagues within the framework of the "foetal programming hypothesis". A large number of epidemiological studies have demonstrated small but appreciable correlations between low birth weight and increased risk of diabetes (Hales et al., 1991), heart disease (Elford et al., 1991; Rich-Edwards et al., 1997) and hypertension (Whincup et al., 1992; Curhan et al., 1996). Although there is yet no firm evidence of the causal importance of these associations, the interpretation has been that small babies have suffered intrauterine growth retardation (IUGR), which, in addition to affecting overall size and proportionality, has also selectively reduced the size and altered the function of various organs (eg liver, kidneys) to spare the growth of the brain. These individuals thus adapt or are "programmed" to an impoverished intrauterine environment. Following birth the programming causes them to respond adversely to high calorie, high fat, and high sodium diets, as well as to obesity, later in life. Of course such pre-natal insults are common in developing countries and exposure to high fat diets is now also common in South Africa following apartheid.

SUMMARY AND CONCLUSIONS

Whilst it is evident that the environments of

the majority of developing countries do not lend themselves to situations in which obesity, and its associated morbidity and mortality, becomes highly prevalent, this situation is altering rapidly. In countries that are going through an economic and nutritional transition, as they become "developed", the population becomes rapidly urbanised and adopts the dietary and physical behaviour patterns common to the developed world; a high fat, high energy, low fibre diet and inadequate amounts of regular physical activity. This combination inevitably leads to childhood and adult obesity that results in increased morbidity and mortality.

The problem for those with the knowledge, skill, and influence to intervene in developing countries is knowing at what level of development to intervene with a package that allows development to proceed with responsibility towards Milton's "fruit of that forbidden tree, whose mortal taste brought death unto the world and all our woe". (Milton *Paradise Lost*)

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KEYWORDS Obesity. Children. Developing Countries. BMI

ABSTRACT Childhood obesity is recognised as a global epidemic with morbid consequences such as peripheral and hepatic insulin resistance, increased blood pressure and plasma cholesterol, sleep-disordered breathing, and orthopaedic disorders of the hips and knees. In addition, there are psychosocial consequences of obesity such as social isolation, dissatisfaction with body shape, low self-esteem and lower educational attainment. Whilst obesity has been accepted as a problem in developed, industrialised societies, it is now becoming evident that the prevalence of obesity amongst children in developing countries is increasing significantly. This paper reviews the evidence for childhood obesity in developing countries and discusses why the prevalence is increasing rapidly. In developing countries that are going through an economic and nutritional transition the population becomes rapidly urbanised and adopts the dietary and physical behaviour patterns common to the developed world; a high fat, high energy, low fibre diet and inadequate amounts of regular physical activity. This combination inevitably leads to childhood and adult obesity that results in increased morbidity and mortality.

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