Regional Case Studies – Africa

Andrew M. Prentice

MRC International Nutrition Group, London School of Hygiene and Tropical Medicine, London, UK, and MRC Keneba, Keneba, The Gambia

Abstract

Africa is the final continent to be affected by the nutrition transition and, as elsewhere, is characterized by the paradoxical coexistence of malnutrition and obesity. Several features of the obesity epidemic in Africa mirror those in other emerging nations: it penetrates the richer nations and urban areas first with a strong urban–rural gradient; initially it affects the wealthy, but later there is a demographic switch as obesity becomes a condition more associated with poverty, and it shares many of the same drivers related to the increasing affordability of highly refined oils and carbohydrates, and a move away from subsistence farm work and towards sedentary lifestyles. Africa also has some characteristics of the obesity epidemic that stand out from other regions such as: (1) excepting some areas of the Pacific, Africa is probably the only region in which obesity (especially among women) is viewed culturally as a positive and desirable trait, leading to major gender differences in obesity rates in many countries; (2) most of Africa has very low rates of obesity in children, and to date African obesity is mostly an adult syndrome; (3) Africans seem genetically prone to higher rates of diabetes and hypertension in association with obesity than Caucasians, but seem to be relatively protected from dislipidemias; (4) the case-specific deaths and disabilities from diabetes and hypertension in Africa are very high due to the paucity of health services and the strain that the ‘double burden’ of disease places on health systems.

Introduction

The paradoxical coexistence of malnutrition and obesity in Africa is made vividly apparent by a visit to almost any major hospital in urban Africa where children’s wards are struggling with infectious diseases and the rehabilitation of severely malnourished children, whilst neighboring adult wards are dealing with amputations of diabetic feet and other consequences of obesity-related
comorbidities. Here we summarize some of the available evidence and seek to contrast the African situation with the case studies from India and China of the preceding chapters [1, 2].

The Epidemiology of Underweight and Overweight in Africa

In sub-Saharan Africa, progress towards meeting one of the key indicators of the first Millennium Development Goals – the proportion of underweight children – is slow and in several countries is in reverse. Current projections indicate that Africa will not meet its target by 2015 [3]. Africa is still the home of the most acute nutritional emergencies with unacceptably high levels of severe acute malnutrition. These are largely in regions of conflict and in countries failed by their political leaders. Figure 1 shows clearly how Africa dominates the world for many infectious diseases (here illustrated by malaria) and under 5-year mortality, comes second to South East Asia in terms of the proportion of underweight children, and is barely visible in terms of gross domestic product wealth. Distressingly Africa also dominates the global picture of countries in serious economic decline.

Proportions of the adult population with a body mass index (BMI) of <18.5 (set as the definition of chronic energy deficiency) are substantial, but less than in many South Asian countries [1, 2, 4], and are a lesser concern. Adult height is also greater than in many Asian countries. In mothers the larger adult stature than in the Indian subcontinent is accompanied by

Fig. 1. Africa – the continent left behind by development. Countries have been resized according to the size of the problem being illustrated. Reproduced with permission from www.worldmapper.org
larger mean birthweights and a lower proportion of low birthweight babies [5].

Yet obesity rates in Africa are escalating fast [6, 7]. The increase is especially rapid in urban areas, though the trends are by no means confined to Africa’s cities. There are several features of the obesity epidemic in Africa that mirror those in other emerging nations: it penetrates the richer nations first (in Africa these tend to be in North Africa); it penetrates urban areas first with a strong urban–rural gradient, but this diminishes with time; initially it affects the wealthy, but later there is a demographic switch and obesity becomes a condition more associated with poverty (as in Western nations) [5, 8], and it shares many of the same drivers related to the increasing affordability of highly refined oils and carbohydrates, and a move away from subsistence farm work and towards sedentary lifestyles [9]. Because the obesity epidemic is advancing so rapidly (making national statistics out of date even before they are published) and because data collection systems in Africa are poorly developed, we will not attempt to provide a survey of the latest transcontinental trends. Selected data can be found elsewhere [7]. Here we concentrate instead on outlining features of the obesity epidemic that differ between Africa and other regions and have to rely on ‘micro-data’ from a few individual studies to illustrate such features.

Figure 2 shows data from a nationally representative survey in The Gambia [10] to illustrate the rural–urban and gender gradients that are frequently reported in Africa. It shows that obesity is virtually unknown in rural areas in both sexes and across all ages. Not surprisingly this is associated with a lower prevalence of obesity-related disease risk factors, though hypertension con-

![Fig. 2. Rural-urban, gender and age trends in obesity in The Gambia. Redrawn from van der Sande et al. [10].](image-url)
Fig. 3. BMI distribution in young and middle-aged Gambian men and women. Redrawn from Siervo et al. [12].

...stitutes a significant problem in rural Africa [10, 11]. In urban areas the average prevalence of obesity (BMI >30) exceeded 30% in women aged 35 years and above. In men, however, there was virtually no obesity until 45 years and even then the rates were a fraction of those in women. Figure 3 illustrates the results from a smaller survey from which the BMI distribution can be plotted for men and women in two age bands (14–25 and 35–50 years) [12]. The gender differences are even more striking as is the development of obesity with middle age in women.

A recently published meta-analysis of 13 studies in West Africa confirms the urban–rural gradient with an odds ratio in urban areas of 2.7 (95% CI 1.7–4.6) [6]. In the same publication a meta-analysis of 26 studies also confirmed the strong sex differences in prevalence with an odds ratio of 4.8 (95% CI 3.3–7.0) in rural areas and 3.6 (95% CI 2.5–4.0) in urban areas [6].

Interestingly a study from urban Benin suggests that although obesity and abdominal obesity rates are much higher in women that in men this does not translate to higher rates of hypertension, hypertriglyceridemia or diabetes [8].
Features of the Obesity Epidemic Characteristic of Africa

The fact that Africa has certain characteristics of the obesity epidemic that stand out from other continents may be pertinent both when considering preventative strategies and in predicting the future trends in the epidemic and its likely associated comorbidities. The following are notable differences.

Cultural Acceptability of Obesity in Women

Apart from certain Polynesian islands, Africa is probably the only region in which obesity (especially among women) is viewed culturally as a positive and desirable trait. There is a long and widespread history of fattening ceremonies in Africa, occasionally in men, but much more commonly in marriageable women. Although these are now almost unknown in a ceremonial sense there remain widely discernible echoes that still resonate in modern Africa [7, 13]. These fuel a syndrome of intentional weight gain in young women with fattening and appetite-stimulating drugs widely available in pharmacies, at least in West Africa.

Figure 4 illustrates data gathered from urban Gambians using the Figure Rating Scale (a series of 9 silhouettes of men and women of differing fatness) to examine attitudes towards body size. Men and women were asked to select the ‘thinnest acceptable’, ‘normal’ and ‘fattest acceptable’ images for both their own and the opposite sex [14]. The results are compared to previ-
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Previously published data from US black and white women. The notable features are that Gambian women are more obesity tolerant than men, but that, on average, Gambians viewed large body size as much more acceptable than Americans. Especially noteworthy is the fact that Gambian women’s perception of normal weight is higher than American's views of fattest acceptable weight.

A further factor that has been frequently cited in Africa, though which lacks any formal assessment, is that the high prevalence of AIDS in many sub-Saharan countries also favors fatness because the reverse, i.e. thinness, might be interpreted by peers as a sign of infection.

These cultural drivers have almost certainly lead to major gender differences in obesity rates in many countries described above, and create an uphill slope for health education programs extolling the maintenance of a healthy bodyweight. There are signs, however, that Western ideals associating female slimness with wealth, health, power and influence are starting to penetrate the most educated strata of urban African societies, and gyms and exercise classes for women are starting to proliferate.

**Altered Genetic Predisposition to the Major Obesity-Related Chronic Diseases**

A general consensus has been that Africans seem genetically prone to higher rates of diabetes and hypertension in association with obesity than Caucasians, but seem to be relatively protected from dyslipidemias [15, 16]. More recent work shows that these interrelationships are more complex and
that the role of environmental factors that differ between racial groups has been underestimated [17, 18]. Intriguingly we should reach a much more comprehensive understanding of underlying genetic susceptibilities in the next few years as a result of a vastly increased capacity to analyze large amounts of genetic data. In the past 2 years genome-wide association studies have identified at least 11 new genes linked to type 2 diabetes mellitus [19] and similarly rapid progress is likely to emerge in other complex trait obesity-related diseases such as hypertension. Advances in bioinformatics and the development of new statistical methods using a variety of methods to interrogate haplotype patterns now permit us to test whether individual gene variants have been the subject of recent selective pressure [20, 21], and whether there has been differential selection within each of the major racial groups [22, 23].

**High Case-Fatality Rates Associated with Obesity-Related Diseases**

The case-specific deaths and disabilities from diabetes and hypertension in Africa are very high due to the paucity of health services and the strain that the ‘double burden’ of disease places on health systems. For instance, a decade ago McLarty et al. [24] pointed out that death rates from diabetes in Tanzania were higher than in the US and Mauritius where the prevalence of disease was much greater. Similarly rates of detection, treatment and control of hypertension fall far short of those in more advanced countries [25]. There is no reason to conclude that the situation in Tanzania is worse than in most other sub-Saharan countries, indeed it is probably better than many.

**The Coexistence of Obesity and Undernutrition within Households**

Since the topic of this symposium is ‘Emerging Societies – Coexistence of Childhood Malnutrition and Obesity’, the literature has been reviewed in a search for data from Africa specifically on this issue. Only a single study was found from urban Benin, the results of which are summarized in figure 5 [26]. The conclusion was that 16% of families had at least one undernourished child coexisting with at least one overweight adult. Note, however, that the definition of overweight was set only at a BMI of 25 rather than the 30 used in some studies from Latin and South America [27], suggesting that, as yet, the problem is not so great in Africa. Nonetheless it is not infrequent to see the mothers of children admitted to therapeutic feeding centers for severely malnourished children looking well-nourished and affluent, emphasizing the dual burden of disease and the fact that malnutrition is frequently precipitated by the high levels of childhood infections (especially diarrhea) in Africa.
Conclusions

Like other rapidly emerging areas of the world Africa is feeling the impact of the dual burden of disease often described as ‘the unfinished agenda of infectious diseases and the emerging agenda of non-communicable diseases’. There are several features of the developing epidemic of obesity that differ characteristically from other regions. Several of these are detrimental, especially the very high debility and case-fatality rates associated with non-communicable diseases in Africa, but there may be one area in which Africa might hope for a better long-term prognosis than Asia. African women tend to be significantly taller than Asian women and suffer less central obesity. This may be significant in terms of the rate at which Africa can emerge from the nutrition transition. It is arguable that Africa will suffer a lesser burden of chronic disease than Asia in which the ‘Developmental Origins of Health and Disease’ thesis predicts a major future burden of chronic disease based upon the mismatch between the fetal and adult nutritional environment [28].

References

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Discussion of the Forgoing 3 Chapters

Dr. Wickramasinghe: My question is for Dr. Reddy. It is very clear that there is an increased intake of food of animal origin. In your talk you said that there is a decrease in protein consumption. Do you mean that there is a tendency to eat less animal protein?

Dr. Bongga: My question for Dr. Yin is that I didn't see the prevalence of anemia among pregnant and lactating women, and could that perhaps in a way be a risk factor for the high prevalence of anemia in children?

Dr. M.A. Chowdhury: A question for Dr. Prentice: we know that malnutrition is found mainly in lower socioeconomic conditions and overweight in higher socioeconomic conditions, but in your study both undernutrition and obesity are found in the same family. What are the predisposing factors for having both conditions in the same family?

Dr. Balhaj: I have a question for Dr. Prentice. You showed us a striking graph that at the age of 24–32 months there is a big drop in the BMI and the head circumference of these children. Is there any explanation for this? Is it due to the introduction of solid foods after weaning or breastfeeding or are there any other contributing factors?
Dr. Jatana: I have a question for Dr. Yin. The anemia levels improved over the years. Was there a program or was it just dietary intervention which improved anemia in China?

Mrs. Gravereaux: This is a question for Dr. Reddy. I was just wondering whether you know why undernutrition decreases with age in women?

Dr. Mathur: From all the speakers in this session on the epidemiology of the nutrition transition in relation to obesity, it appears that the paramount determinant is economic development. However, when we look at the intervention trials on obesity, behavior modification has been largely attempted [1, 2]. We would have benefited from data and experience being shown for those behavioral risk factors in tackling the obesity epidemic, including the nutritional component of obesity.

Dr. Jaigirdar: This is a question for Dr. Reddy. People from the subcontinent have very low HDL levels. It is one of the great risk factors of ischemic heart disease, especially in the subcontinent. The HDL level can’t even be increased with diet, exercise, or drugs. Is there a reason for this?

Dr. Al Waili: To Dr. Yin: you showed us that the subjects have low vitamin A deficiency. Is it because they have a low protein deficiency? Did you look for that, because we know that if they have low protein deficiency they might get vitamin A deficiency, or is it only because of the diet?

Dr. Giovannini: In all the studies did you see any relationship between birthweight and obesity? After the long period of breastfeeding, is the nutritional risk of obesity mostly related to a Western-type diet? These factors may be important. An important point in the Chinese presentation is beef intake, because between the rural and urban areas, beef intake is different. Regarding the Asian study, experience from Cambodia, where children don’t receive beef, has shown that beef is the best food for men, secondary for women and least for children. This is also very important, and should be correlated to China where the rate of breastfeeding is traditionally very low.

Dr. Popkin: The critical period is weaning from 6 to 12 months which exists in China. However in India we have both the low birthweight problem and the weaning quality problem. I wonder if we are finding across all 3 countries weaning food changes with economic change and if that is an explanation for some of them? But now I want to turn to the other side of the coin for India. Is there any place in India were healthy normal BMIs can be found for adults? India, for reproductive reasons, has a very long history of women with BMIs of 16–18 producing and feeding babies. Now if suddenly their BMI goes over 18 and 20, are they already at risk of diabetes, and do we have very little room for something that we would call normal weight and normal body composition?

Anonymous: I would like to confirm Dr. Prentice’s observation in The Gambia about women and men. The issue of attitude is very important. Do you have any experience with adolescents because Indian girls are now becoming thinner and boys are getting fatter? There seems to be a reversal in adolescents.

Anonymous: This is a question for Dr. Reddy. You said that across India women aged 14–19 are undernourished, and this declines within the age. Why does this happen? Dr. Bohles: I have a question for Dr. Prentice. Is there any difference between Eastern and Western Africa? There is a genetic difference in the muscle fiber distribution: in Eastern Africa there is a predominance of type 1 muscle fibers and in Western Africa of type 2 fibers. People with a dominance of type 1 fibers are genetically skinny because type 1 fibers burn up fatty acids as their energetic basis. Is there a difference in the tendency to obesity with respect to East Africa?

Dr. Matthai: Three points. When we define malnutrition we talk in terms of weight for age, and when we talk of obesity we talk in terms of BMI. That seems unscientific. Second, we are bringing down our values for expected BMI, perhaps we should
change our standards for defining malnutrition as well. Third, when we say normal requirements for children, for example a 10-year-old child needs 2,000 cal, are we recommending more than what they really need considering genetic background and environmental factors. In other words, when we are preventing or treating malnutrition, are we sowing the seeds for obesity?

Dr. Pandit: It is generally perceived that if there is a shift in the BMI between the age of 6 and 9 years the risk grows considerably, but in the first 2 years of life there is no risk at all as shown by studies from Delhi, Finland, etc. I did not see these patterns in any of the 3 presentations. Could Dr. Reddy elaborate on that? Did you use the Cole standard for BMIs in children, because it is very tricky when the measurements are done.

Dr. Prentice: We have a great number of questions to answer, so I hope you will forgive me if I answer some of these rather rapidly. The first one was the question of what are the predisposing factors within those families who do show the coexistence of malnutrition in a child and obesity in the parents? Hopefully Dr. Sawaya and others will discuss this later, so I will just give a quick answer here. Those that I see, and again this is from the literature, especially a recent paper from Benin [3], is that surprisingly a high socioeconomic status is associated with this coexistence, so there are children in high socioeconomic families who have malnutrition. Generally this is because the mother doesn’t know how to look after her child or because the child is HIV-positive and/or because that child has some severe infection that predisposes him to undernutrition. The issue of diet diversity is also being reported as being important. Those families who have this coexistence have a less diverse diet than those who don’t.

The next question is related to the rapid decrease in nutritional status in The Gambia. In fact there was a misunderstanding that the x-axis there was weeks, not months, so in fact it is from 3 months to 1 year where there is a precipitant drop, and this is really caused by very poor quality weaning foods. This addresses Dr. Popkin’s question also; these foods are very thin nutrient-weak ‘monos’, as they call them, gruels and porridges. These lead to high rates of infection, as they start to introduce other weaning foods that are highly contaminated.

One questioner stressed that we talked a lot about economy and not a lot about behavior in terms of the risk factors. Those are of course related, the increasing economy allows people the behavior of eating more animal fats, more highly refined oils and carbohydrates, etc. It is enormously complex and it is an agenda that is moving by the month even in Africa. I am going to answer this in relation to the Nigerian question about adolescents as well. One now sees adolescent girls in Africa jogging, going to aerobics and to the gym, something I would have never dreamed of seeing even 5 years ago. They have their TV satellite dishes, they see their models of skinny people from the United States, things are changing. As you said the boys very often want to build muscle and increase body mass. So, yes, things are changing, and in terms of behavior it is difficult to get on top of this because it is such a moving target all the time, but it is clearly something we need to.

There was a question about Eastern vs. Western Africa and the differences in muscle fiber types. An interesting question, and I agree it would be lovely to get some detailed research on this. I am not aware of any, the only thing I can say is that there are lots of very overweight women in East Africa as well.

The final question that was addressed to me was whether in trying to treat the malnutrition issues we are sowing the seeds of obesity. Yes that very often is the case and what we must avoid. There was an interesting case study from Chile where there were very high levels of childhood malnutrition. They had a government-driven institutional supplementation program with high calorie-dense foods, and when after 20 years
it was looked at again for the first time, they found that actually they were feeding
children who were already overweight and obese so they quickly stopped that.

Dr. Yin: These are very good questions The first was about anemia prevalence. In 2002 we investigated anemia problems for the whole population using sampling, and the highest prevalence is in small children and pregnant women. The averaged national prevalence of anemia was about 28.9 and 30.7% in pregnant and lactating women, respectively [4, 5].

The second question was about the improvement in anemia levels over the years. Iron deficiency and iron deficiency anemia are still serious problems based on the 2002 National Nutrition and Health Survey [5]. This survey showed that the anemia prevalence in children (6–9 years) was 13–14% in cities, indicating that these children are at a high risk of having anemia. For this reason the Chinese government started an iron fortification program. The introduction of fortified soy sauce with EDTA-Fe was carried out 5 years ago, now the fortified soy sauce is sold in markets approved by the Chinese regulation [6].

The third question was about vitamin A deficiency in children. Serious vitamin A deficiency and other forms of malnutrition in children are not very common. However, the incidence of marginal vitamin A deficiency (about 40% in children aged 3–12 years) is relatively high based on the 2002 National Nutrition and Health Survey [5]. The insufficient vitamin A in the diets was the direct cause of the marginal vitamin A deficiency, and most of the retinol equivalents were from plant foods [7].

Another question was about malnutrition and very low breastfeeding in China. But how low; I wonder how to evaluate it. The data show that breastfeeding is about 72% over 4 months, but the problem is the time of weaning. At about 10–11 months of age the children will have stopped breastfeeding; so why do most of the women stop breastfeeding very early. Another problem is the weaning food, the complementary feeding, which needs further work.

Dr. Reddy: Several questions were addressed and I will try to respond as directly and as briefly as possible to each of them. The first question was why protein consumption is decreasing if animal food consumption is increasing? Firstly these are national summary statistics. Animal food consumption is probably increasing in the higher socioeconomic groups, but pulses particularly are becoming overpriced at the moment and pulse consumption is certainly declining all over and mostly affects the lower and middle socioeconomic groups. Therefore one of the major staple sources of protein is actually declining which will result in decreasing protein consumption.

The second question was why women in the younger age group have greater evidence of undernutrition but with increasing age they actually move towards obesity. Again these are the results of cross-sectional studies and do not capture the lifespan experience of a cohort. It will be very difficult to say if this transition is occurring in the life course of a single individual or in the same cohort. However the explanation is likely that in the younger age groups there is a higher level of physical activity, with younger girls particularly taking part in a lot of domestic duties plus of course carrying out other work outside home including schooling and other related activities. By the time the women marry, there is child rearing, which is certainly a physically intense effort, and household chores. By the time they cross the 44-year age barrier, much of these physically arduous duties disappear and then the physical inactivity component rises substantially. This is what I would surmise, but we cannot prove it because there are no cohort studies or multiple behavior type studies.

Coming to behavioral factors, Dr. Mathur raised the question why we talk about economic policy interventions rather than focusing on behavioral indicators, which have been the main focus of attention in various trials. I think the researchers have essentially focused on what they believe they can change, whether they can actually
change behaviors or not is a different issue. On the contrary populations are likely to be profoundly impacted by policy interventions even in a short time because they have a population-wide impact. We know this from a variety of interventions, for example how the rationale was changed in Mauritius from palm oil to soya oil and that resulted in a fairly large decline in plasma cholesterol concentrations within a matter of 5 years. Similarly we know what happened in Poland where, for example, the withdrawal of subsidies from animal foods and the import of vegetable oils, and of course of fruits and vegetables, changed the cardiovascular mortality patterns. So we know that through pricing mechanisms, which have a population-wide impact, even if the interventions are non-personal, a considerable impact can be attained in the short-term. But of course we do need to look at the behavioral factors as well and there are multiple studies currently going on which I believe will give a greater indicator. But unless we change the environment to help people make and maintain healthy choices, all the behavioral interventions are unlikely to have a full impact.

In terms of HDL levels, yes Indians seem to be afflicted with a particularly low HDL level. Whether this is a part of the metabolic syndrome complex due to low physical activity, increased insulin resistance, we don’t know, but we know that insulin resistance is very high among the people of South Asia. But how much of it is conditioned in utero; how much of it is actually a thrifty gene hypothesis; how much of it is conditioned during the course of adolescence and adult life; it is difficult to tease out. I would speculate that even if we looked at the Barker hypothesis there is a rationale for having a low HDL. If you have intrauterine malnutrition and you want to ensure that your nervous system growth is absolutely ensured for survival then the HDL, which allows more tissue deposition of fat, would have to be lower, and the LDL would have to be higher. I would therefore look at what I call evolutionary survival epidemiology in terms of the Barker or the thrifty gene hypothesis. However I believe that a lack of physical activity is one of the critical events throughout the lifespan and, particularly in adolescence and adulthood, we are increasingly becoming physically inactive, and unless we change that we are not going to be able to change the HDL levels. Whether there are additional factors like low n-3 intake, whether there are additional nutritional factors, I cannot at the moment surmise but these are all areas of research.

In terms of low birthweight and weaning, the pediatricians in the audience keep talking about the very low rates of continued breastfeeding after 6 months and beyond, as well as the low levels of complementary feeding from 6 months onwards and these are two critical factors that need to be corrected if we want to do something about the 0–3 malnutrition. Continued breastfeeding has certainly to be looked at as an important public health intervention.

Dr. Popkin’s provocative question, what is normal BMI for adults in India. I suppose in the absence of cohort studies it is going to be a little difficult to say what the adverse outcomes at different BMI levels are. Also in the Indian context it becomes even more challenging when we recognize that at any BMI level the percentage of body fat is quite different from Caucasian populations. Therefore we do need some independent predictors from good cohort studies.

Dr. Pandit asked which criteria were used. In our study we used both the Cole as well as Agarwal criteria, and then we have different levels. As you know in comparison to the Agarwal criteria, the Cole criteria overestimate undernutrition and under estimate overweight, but we used both and we have figures from both. The other question that Dr. Pandit posed: it is generally perceived that cardiovascular disease risk factors considerably increase when the BMI changes between 6 and 9 years but not if it changes between 0 and 2 years, do you agree? From the study that I conducted, the so-called rebound adiposity or catch-up growth, it seems to be coming up much more after 2 years between 2 and 12 or 6 and 9 years, so that could be an important
vulnerable age group and we need to consider that. But coming back to the larger question, which is linked to yours, are we setting the stage for obesity and overweight by trying to correct malnutrition? I grapple with this question whenever I have to discuss the Barker hypothesis. I find it very difficult to give a public health recommendation that people who are born small with a nutritional impairment should not have nutritional correction, but adequate nutrition need not be inappropriate nutrition. We need to make sure that fruit and vegetable consumption and fiber components are much more balanced, and not just pump calories into these children. Secondly I believe it is very essential for these children who are at a high risk of insulin resistance to become physically very active. Therefore we need other public health interventions to complement and not just give nutritional corrections to these children. I think we ought to look at the larger picture.

References