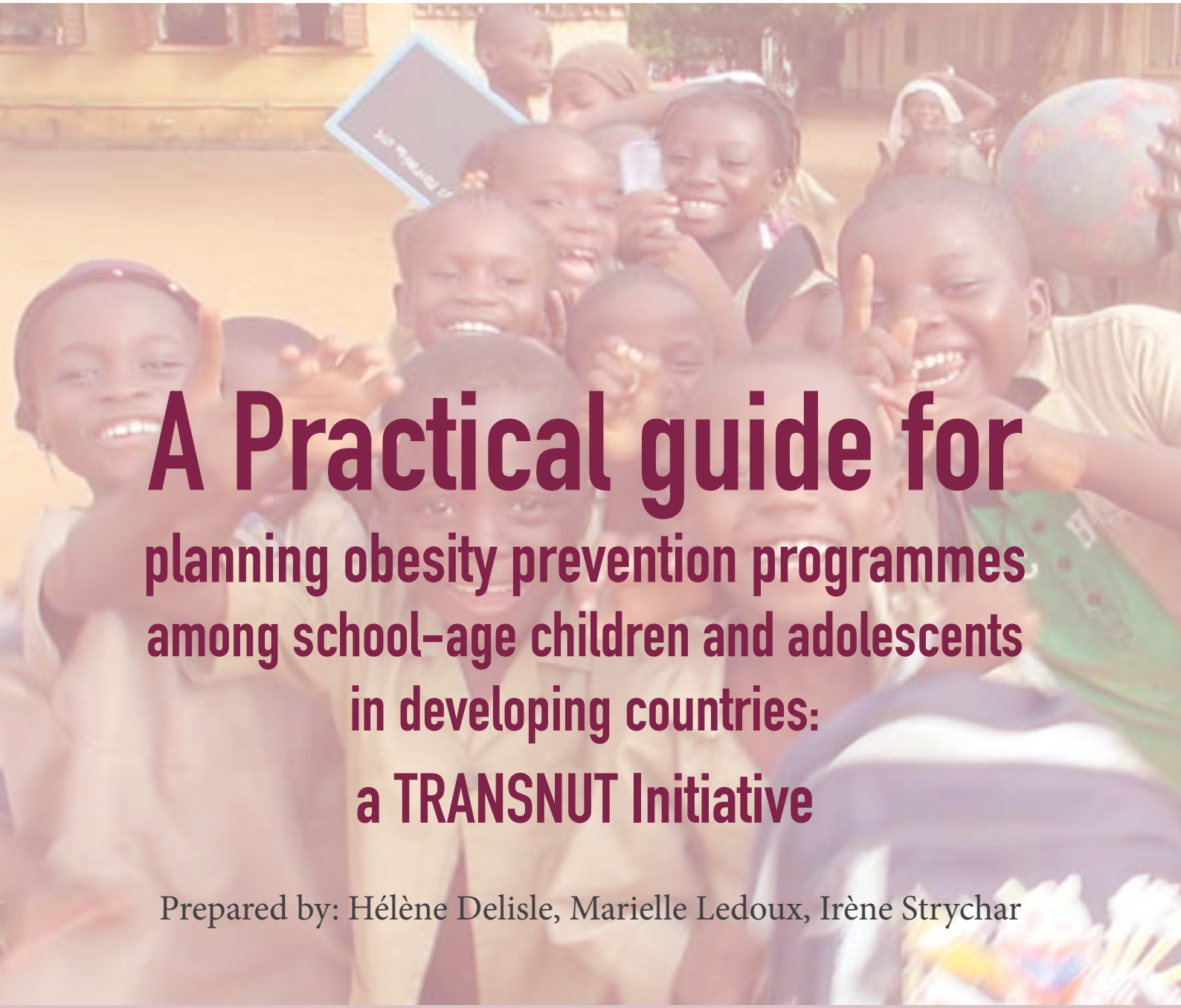
Faculté de médecine
Département de nutrition
Université de Montréal

transnut

Organisation mondiale de la Santé

Centre collaborateur OMS sur la transition nutritionnelle et le développement, Canada.



A Practical guide for

planning obesity prevention programmes among school-age children and adolescents in developing countries:

a TRANSNUT Initiative

Prepared by: Hélène Delisle, Marielle Ledoux, Irène Strychar

TRANSNUT IS A WORLD HEALTH ORGANIZATION COLLABORATING CENTRE ON NUTRITION CHANGES AND DEVELOPMENT

Department of Nutrition
Faculty of Medicine

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF BOXES

LIST OF APPENDICES

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EXECUTIVE SUMMARY

Childhood obesity has become an epidemic and marked rising trends are apparent in both developed and developing countries. It is but one symptom of a dysfunctional socio-economic system at the global level. The social and health consequences of obesity, including related co- morbidities, cannot be underestimated. It is expected that by 2020, approximately 70% of all deaths worldwide will be due to chronic diseases, and 80% of the burden will be observed in developing countries. To compound the problem, several low and middle income countries are now facing the double burden of obesity and malnutrition. Prevention is a key strategy in the fight against obesity and it is a shared social responsibility. A multifaceted, multi-disciplinary approach is required to meet the challenging goal of modifying the environment and lifestyle patterns. School-age children and adolescents may be considered a priority target.

This manual is designed to provide a hands-on guide for health and nutrition professionals to plan, implement and evaluate obesity prevention programmes for school-age children and adolescents in developing countries, particularly in the school setting. Several practical tools are suggested, including for the assessment of obesity and of its proximal determinants, that is, eating and physical activity patterns. Models and conceptual frameworks are discussed because action has to be grounded in sound theory. We provide a 5-step guide to planning healthy nutrition promotion and obesity prevention interventions, which we adapted from the PRECEDE-PROCEED model of Green. The steps consist of community and individual assessments, identification of targets for change (community, family, individual level), choice of objectives, design of programme methods, and procedures for the evaluation. In order to foster effective programmes to promote healthy nutrition and lifestyle among school-age children and adolescents, we discuss theoretical models of behaviours change that may be appropriate (Health Belief Model, Theory of Planned Behaviour, Social Cognitive Theory, Stages of Change, Transtheoretical Model).

The opening chapters of the manual provide the rationale for interventions to prevent obesity at school-age in developing countries, reviewing the consequences and providing data on the current prevalence of the problem. The last chapter addresses policy and programme issues. Appropriate action can only be undertaken if decision makers are convinced of the gravity of the obesity problem and the urgency to act, which is not yet the case in several developing countries confronted with the double nutritional burden. This underlines the need for advocacy. Issues regarding the evidence of programme effectiveness are also addressed.

1. INTRODUCTION

Humanity has, by and large, moved beyond hunger and premature death. It is now confronted with the opposite problem of obesity and related chronic diseases. Obesity has become endemic. WHO global estimates in 2008 were that more than 1.4 billion adults (20 and older) were overweight, among whom over 200 million men and nearly 300 million women were obese (Misra & Khurana, 2008). Overweight/obesity in children and adolescents[1] parallels the epidemic in adults (WHO, 2000). In 2006, 30-45 million children and adolescents (age 5-17) were obese, or 2-3% of the world population. Approximately 150 million children/adolescents were either overweight or obese, or 7-8% worldwide (Bouchard, 2006). By 2012, more than 40 million children under the age of 5 were overweight or obese (WHO, 2014). Even low income countries are increasingly affected. In the year 2020, approximately 70% of deaths will be due to chronic diseases, and 80% of the burden will be observed in developing countries (WHO, 2010). Obesity is an underlying risk factor in numerous chronic diseases. Overweight and obesity now ranks as the fifth highest global risk factor for mortality and is the cause of an estimated 35.8 million (2.3%) of global DALYs (disability-adjusted life years) lost (WHO, 2010).

The galloping rate of obesity in a short amount of time in fairly stable populations suggests that a genetic origin is most unlikely, even though genes have a permissive role in the sense that some individuals may be genetically more susceptible to the obesogenic influences of the environment. The obesity pandemic reflects the widening gap between biology and lifestyle. At the international level, this major public health concern led to the adoption, by the World Health Assembly, of a global strategy on diet and physical activity in 2004. . This strategy remains highly relevant and was reiterated at the High level Meeting on non-communicable diseases held in New-York in 2011 (UN 2012). The need for prevention is ever more compelling as obesity rates continue to rise in low-income countries and long-term treatment success remains low. Children and adolescents should be regarded as priority target groups for prevention as these are unique periods for moulding health-related behaviours. Evidence shows that obese children particularly at school age tend to become obese adults (Whitaker et al, 1997; Nader et al, 2006), and once obesity is established, it is difficult to reverse through intervention (Littikhuis et al, 2009).

This manual offers a practical guide for health and nutrition workers involved in developing, implementing and evaluating obesity prevention programmes for children and adolescents in low and middle-income countries, particularly through school-based initiatives. After an overview on the gravity of the problem and the urgent need for action, guidelines are presented to assist in diagnosing the current situation, constructing appropriate and focused programmes, and evaluating the outcomes of the interventions. Methodological issues related to the measurement of obesity, dietary patterns and intakes, and physical activity, are also addressed. It is hoped that this manual will incite health and nutrition workers to integrate obesity prevention into their intervention programmes targeting children and adolescents. It can also serve as an academic guide for professors and students of programmes focussing on global nutrition and on nutrition in developing countries.

The production of this manual is an activity of TRANSNUT, a WHO Collaborating Centre on Nutrition Changes and Development at the Department of Nutrition, University of Montreal, Quebec, Canada.

1 WHO has defined « adolescents » as people in the 10-19 years age range, and « youth », as those between 15 and 24 years of age.

2. WHY INCREASING OBESITY IN CHILDHOOD IS A GLOBAL CONCERN ?

Obesity now occurs in both developed and developing regions around the world. In 2009-2010, an estimated 35.7% of U.S. adults aged 20 and over were obese, which indicated an increase from a previous level of 23% in NHANES III (1988-1994). Between 1976-1980 and 2009-2010, the obesity prevalence increased from 6.5% to 18% among US children aged 6-11 years, and from 5.0% to 18.4% among adolescents aged 12-19 (CDC, 2010; Ogden et al, 2010, 2012; Fryar et al, 2012). In Canada, the prevalence of obesity increased from 6.3% to 12.7% between 1978-1979 and 2004 among children and youth (Roberts et al, 2012). Worldwide, 43 million preschool children, including 35 million in developing countries, were estimated to be overweight or obese in 2009-2010 (de Onis et al, 2010).

Increasing trends are also observed in developing country children as will be discussed in chapter 3. Furthermore, the coexistence of obesity and malnutrition at country level and even in the same households has become a reality in several developing countries (Bouzitou Ntandou et al, 2005; Doak et al, 2005; Raphaël et al, 2005; Jehn & Brewis 2009; Zeba et al, 2012). The dual nutritional burden of malnutrition and obesity has to be addressed. The challenge for decision makers is to recognize the gravity of the obesity problem, even in areas where malnutrition persists, so as to allocate sufficient personnel and financial resources to tackle this major public health problem.

Childhood obesity is a global concern for several reasons: co-morbidities are observed already in children, obesity tends to track into adulthood, social stigmatisation of overweight and obesity may lead to eating disturbances at an early age, and obesity has enormous socio- economic consequences.

2.1 Co-morbidities

A review of the hormonal and metabolic aspects of childhood obesity can be found elsewhere (Artz et al, 2005). Obesity is one component or abnormality of the metabolic syndrome, defined as a clustering of cardiovascular disease risk markers which include high blood glucose, high blood pressure and abnormal blood lipid concentrations (Alberti et al, 2009). Studies have reported that between 25% and 50% of obese children are affected with this syndrome, depending of the severity of obesity and race- ethnicity groups (Invitti et al, 2006; Rodtriguez-Moran et al, 2004; Weiss et al, 2004). Obese children and adolescents are also more likely to have serious health conditions such as hepatic and gallbladder diseases (Strauss et al, 2000), respiratory problems (Figueroa-Munoz et al, 2001), renal problems (Adelman et al, 2001), skin problems and infertility, chronic musculoskeletal problems (Chan & Chen, 2009) and lower health-related quality of life (Tsiros et al, 2009).

In all countries of Latin America, non-communicable chronic diseases (NCD) together represent the first cause of death. It is important to point out that of all the risk factors associated with mortality from NCD, obesity is the one that has undergone the largest increase and is now the main nutritional concern in most Latin American countries (Uauy et al, 2001).

Results of the Bogalusa Heart Study show that overweight children were 2.4, 2.5, 3.0, 7.1, and 12.6 times more likely to have elevated diastolic blood pressure, systolic blood pressure, LDL-cholesterol, triglycerides, and fasting insulin levels, respectively (Freedman et al, 1999). Type 2 diabetes, predominantly an adult onset disease, is now a more frequent occurrence among overweight youth. European data indicate that over 1 million children in Europe have at least 3 markers of the metabolic syndrome (Lobstein & Jackson-Leach, 2006).

2.2 Persistence into adulthood

Childhood obesity tends to persist into adulthood, but persistence is strongly dependent on age of onset (Sandhu et al, 2006; Hedley et al, 2004). It is estimated that one-third of obese pre-schoolers become obese adults, but some studies suggest that obesity at 1-2 years is not related to adult obesity (Whitaker et al, 1997). An estimated 50% of obese school-children will remain obese as adults. Overweight children are also at increased risk for becoming overweight during adulthood, by a factor as high as 6.5, compared to those who are not overweight (Freedman et al, 2005a; Ritchie et al, 2001). Even normal-high weight (50th-84th percentile BMI), among 8 to 15 year olds, is associated with a higher risk of adult overweight/obesity (Field et al, 2005).

The likelihood that obesity will persist into adulthood is much higher in adolescence than in younger children (American Academy of Pediatrics, 2003). Obese adolescents are at considerable risk: 3 out of 4 obese adolescents will remain obese as adults. In the 1,000 family cohort study in England, among children born in 1947 and seen again at age 50, only obese adolescents, and not younger children, were at increased risk of obesity (Wright et al, 2001). Sandhu et al (2006) reported that prepubertal BMI in boys was strongly correlated with adult adiposity, BMI and waist or hip circumference. Goldhaber et al (2012) confirmed that obesity in older children or adolescents is more predictive of obesity during adulthood than obesity in younger children.

2.3 Psycho-social consequences including eating disturbances

The social consequences of obesity are dependent on cultural perceptions of body weight and attractiveness. In certain countries and populations, higher weight is viewed as positive and represents health, financial security, and sexual appeal. In Senegalese women, for example, 'overweight' was considered normal and the most socially desirable body size (Holdsworth et al, 2004). Similarly, 14% of African males in the Caribbean classified the overweight female silhouette as being the most attractive (Simeon et al, 2003). South Africa women reportedly wished to attain larger body size because they perceived body images of obese women as ideal (Case & Menendez, 2009). In The Gambia (Siervo et al, 2006), 68% of overweight adults reported that they did not perceive themselves as overweight. Under these circumstances, the challenge is to increase awareness of the magnitude of the short and long-term health risks associated with obesity.

The perception of obesity may have indirect effects on how adults deal with obesity among their children. Page et al (2007) reported that 60% of parents with overweight children in a U.S. study were not able to accurately classify their children as being overweight, with African-American parents being twice as likely to underestimate their children's weight. Perception of being overweight is frequently associated with trying to lose weight and modifying diet and activity levels (Cheung et al, 2007; Page et al, 2007; Siervo et al, 2006).

In contrast, in most developed country societies, thinness is viewed as positive and represents success, control, and sexual attractiveness (WHO, 2000). These views set the stage for eating disorders and for unsafe dieting practices in children and adolescents. Discrimination against obese youth has also been reported; thin children are perceived as having more friends and as being better looking (Woodward-Lopez, 2005), while obese children are often exposed to teasing, discrimination, victimization and social exclusion (Katz et al, 2008). Obesity has been reported to be associated with negative body image and lower self-esteem (WHO, 2000), poorer physical quality of life (Swallen et al, 2005), school absenteeism and poor school performance (Foltz et al., 2012). Obese children are more likely to engage in high-risk behaviours and undesirable stereotyping including perceptions of poor health and poor hygiene (Puhl & Latner, 2007; Strauss, 2000). Prospective studies have also revealed

that obese adolescents are at risk of major anxiety and depressive disorders later in life (Anderson et al, 2007).

Eating disturbances appear in a society when there is a combination of two factors: obesity is widespread, and thinness is the ideal. In industrialized countries, such disturbances, of which bulimia and anorexia represent extremes, are primarily observed in Caucasian adolescent girls. However various degrees of eating disturbances are increasingly observed in non-Caucasians, in males, in less affluent groups, and at a younger age, in the United States (Gard & Freedman, 1996; Wilfley et al, 1996; Storey et al, 1995). In a study conducted among New-England school adolescents (Neumark-Sztainer et al, 1999), it was found that disordered eating tended to be less prevalent among Hispanic and African-American than in Caucasian girls, but among boys, it was more frequent among non-Caucasians.

Eating disturbances are still rare in areas where obesity is not widespread or stigmatised by society, that is in most developing countries (WHO, 2000), but they tend to increase with 'westernization' and media exposure (Littlewood, 2004; Makina et al, 2004; Garrusi & Baneshi, 2013). In Chile, where obesity has been increasing rapidly, eating disturbances have been described, primarily in adolescent girls (Cordella et al, 2006). Many theories have been proposed to explain the relationship between body image disturbances and eating disorders, but it is widely accepted that socio-cultural factors including the media have the strongest influence (Andrist, 2003). A case of anorexia nervosa was reported in a black woman who immigrated from Curaçao to the Netherlands. This case illustrates the role of socio-cultural factors (Willemsen & Hoek, 2006). The woman had voluntarily put on weight while in Curaçao to become more attractive. When in the Netherlands, she wanted to lose weight because being thin was considered attractive in her new environment and she became anorexic. Acculturation can therefore play an important role in the development of eating disorders. In a Fijian study, Becker (1995) reported that 62% of school girls had reported dieting in the past month. This was 38 months after television was introduced, and 83% of these girls said that television influenced the way they felt about their body. Traditionally, Fijians have preferred robust body shapes for men and women as a reflection of social status.

As part of nutrition promotion and obesity prevention, it is therefore important to foster a positive body image and self-esteem among children and adolescents. More research is also needed on the determinants and correlates of eating disorders in the non-Western world, however, to ascertain whether they tend to increase during transition to Westernized diets and lifestyles.

2.4 Socioeconomic impact of obesity

The socioeconomic consequences of obesity are considerable since obesity is associated with increased co-morbidities, including diabetes, hypertension, cardiovascular disease, and certain forms of hormone-dependent and gastrointestinal cancers (WHO, 2000). Treatment costs of such conditions are a significant economic burden in any society.

Obesity is also associated with increased mortality rates (WHO, 2000), particularly among those with a BMI above 35. In the USA, life expectancy is beginning to decrease. When launching the national campaign to reduce obesity among American children, Clinton warned that today's youth could be the first US generation to die younger than their parents[2].

Obesity threatens the health of our economies, as Mr. Kyprianou, the European Commissioner for Health and Consumer Protection, warned[3]. Worldwide, it is estimated that the highest percentage of disability-adjusted life years (DALYs) lost to obesity is related to poor nutrition and physical inactivity, followed by smoking. In developed countries, it is estimated that between 2 and 7% of total health care costs are related to obesity (WHO, 2000). In Europe, up to 10.4 billion Euros are spent on obesity-related healthcare, and the reported relative economic burdens ranged from 0.09% to 0.61% of national Gross Domestic Product – GDP (Muller-Riemenschneider et al, 2008; Chan & Woo, 2010). In the USA, total obesity-related health care costs have trebled

2 New York, May 3, 2005. Clinton heads anti-obesity drive. http://story.news.yahoo.com/s/nm/20050503/hl_nm/obesity_dc&printer=1

3 Brussels, March 15, 2005. Obesity epidemic: Markos Kyprianou pledges action as data shows more children overweight.
http://europa.eu/rapid/pressReleasesAction.do?reference=IP/05/292&format=HTML&aged=0&language= EN&guiLanguage=en

between 1980 and 2000. The direct costs of obesity have been estimated at $61 billion and the indirect costs at $56 billion, comparable to the economic costs of cigarette smoking (NIH, 2005). According to Go et al (2013), the total excess cost related to the current prevalence of adolescent overweight and obesity is estimated at $250 billion, including $208 billion in lost productivity due to premature morbidity and mortality and the remaining $46 billion for direct medical costs. The total health care cost of obesity could reach $861 billion by 2030 if the current rising trends in obesity were to continue. In Canada, the total direct costs attributable to overweight and obesity have been estimated at 6 billion US dollars (66% for obesity alone), corresponding to 4.1% of the total health expenditure for 2006. The direct cost would increase by 25% if related co-morbidities were included (Anis et al, 2009).

The cost of obesity is also high in developing countries. In mainland China, the total medical cost attributable to overweight and obesity in 2003 was estimated at about 2.74 billion US dollars, accounting for 25.5% of the total medical cost for chronic diseases and 3.7% of national total medical costs. The health expenses are projected to rise to $112 billion by 2025 for obesity alone (Zhao et al, 2008). In Latin America and the Caribbean, the WHO estimated that the combined annual direct and indirect costs of obesity-induced diabetes reached $65.2 billion in 2000 (Runge, 2007), while in the Pacific islands, obesity and type 2 diabetes mellitus amounted to $1.95 million in Tonga and $13.6 million in Fiji, consuming roughly 60 and 39% of the health budgets, respectively (Dalton & Crowley, 2002; Misra & Khurana, 2008;).

Studies have suggested that the reduction of obesity and overweight in children could produce short-term economic benefits for children and longer-term benefits for adults (Finkelstein et al, 2005; Trasande, 2010). Prevention of obesity represents a less expensive and more effective approach than treatment, which underscores the relevance of prevention in children (Kesten et al, 2011).

3. TRENDS OF OBESITY IN SCHOOL-AGE CHILDREN AND ADOLESCENTS IN DEVELOPING COUNTRIES

Comparison of trends of obesity in school-age children and adolescents among countries is difficult, partly because of inconsistencies in criteria used to classify obesity in youth (WHO, 2000). Notwithstanding, there are global trends of increasing rates of obesity that require immediate attention.

3.1 Criteria to define obesity in children and adolescents

Defining overweight and obesity in children and adolescents is complicated as height is still increasing and body composition changes over time (Chan & Woo, 2010). Obesity in individuals is generally defined as excess body fat for a given body weight and height. Different measures and references such as weight-for-height, BMI percentiles, and skinfold thickness are used to classify overweight and obesity (WHO, 2000; Huang & Chan, 2009). For public health purposes, obesity is measured using anthropometric measurements and empirical cut-off values. Three sets of reference values are widely used to assess overweight and obesity in children and adolescents. They are based on BMI-for-age. Unlike in adults, BMI assessment requires information on age. The first set of reference values for BMI-for-age are from the International Obesity Task Force (IOTF) and they are based on BMI cut-off points obtained from six national cross sectional surveys on growth in Brazil, Great Britain, Hong Kong, the Netherlands, Singapore and the United States (Cole et al, 2000; Cole et al, 2007). These curves have great potential for international comparisons of overweight and obesity trends across countries worldwide (Wang, 2004; James et al, 2001). The surveys, which included 97,876 males and 94,851 females from birth to 25 years of age, allowed Cole and his team to draw centile curves up to 18 years of age. The curves from the six surveys were then averaged to develop the final curves. The cut-offs for overweight and obesity are given by the centiles of BMI for a specific age that pass through a BMI of 25 and 30, respectively, at age 18. It is recommended that the original IOTF reference curves be maintained rather than updating the data since there is an increasing prevalence of obesity, which would push the cut-offs upwards (Lissau, 2004). However, although the IOTF classification has been used extensively, a systematic review has found that it underestimates obesity in children and adolescents (Reilly et al, 2010).

The second set of reference values for school-aged children and adolescents is that of WHO (de Onis et al, 2007). The WHO/NCHS curves used as international reference data for school-age children and adolescents are based on data collected in the US NHANES (National Health and Nutrition Examination Surveys) between 1963 and 1980 (Dibley et al, 1987). The use of BMI-for-age is recommended for children aged 5 – 19 years. The cut-offs for overweight and obesity are set respectively at +1.0 and +2.0 standard deviation scores. ANTHRO+ software can be freely downloaded from the WHO website[4]. While the WHO growth curves for under-five children represent growth standards, those for school-age children and adolescents are only reference data, not standards. The former are based on longitudinal and cross-sectional data collected in both developed and developing countries among children living in favourable socio-economic conditions, breastfed according to WHO guidelines, and given adequate complementary food. The WHO BMI cut-offs for overweight and obesity appeared to identify a greater percentage of children as overweight or obese than did the IOTF cut-offs in studies conducted in Canada, Brazil and Colombia (Pelegrini et al, 2013; Gonzalez-Casanova et al, 2013; Roberts et al, 2012; Dumith & Cazuza, 2010).

4 http://www.who.int/growthref/who2007_bmi_for_age/en/

In the United States, BMI-for-age data of the Centers for Disease Control (CDC) growth curves of 2000 are used as reference. Values between the 85th and 95th percentiles depict overweight whereas obesity is defined as BMI above the 95th percentile for age; there was a recent change of terminology (Ogden, 2010).

The three sets of BMI cut-off values are summarized in the following box.

BOX 1. BMI cut-offs for overweight and obesity in childhood according to age and sex

	Overweight	Obesity
IOTF: Based on BMI curves from 6 countries (Cole et al, 2000; 2007; Cole & Lobstein 2012).	Percentile or standard deviation score passing through 25 at age 18	Percentile or standard deviation score passing through 30 at age 18
WHO (2007): Based on NCHS reference data	>1.0 SDS	>2.0 SDS
CDC, USA (Ogden 2010), NCHS reference data 2000	85th percentile	95th percentile

There are limitations to the use of BMI cut-offs as a measure of obesity in children and adolescents, and because of these limitations, obesity data should be interpreted with caution. First, the cut-offs are not based on health risk. For instance, BMI categories for overweight and obesity were found to be poor markers for insulin resistance or elevated triglyceride concentrations in children (Voss et al, 2006). Secondly, the data are cross-sectional, not longitudinal. BMI tracking is assumed in the IOTF criteria in the sense that the overweight and obesity cut-offs are the 85th and 95th percentiles (or Standard deviation scores) of BMI curves that go through BMI of 25 and 30, respectively, at age 18. Thirdly, BMI curves do not take into consideration body composition and body fat distribution, which have been estimated to be more valuable than BMI alone to predict the ultimate risks of developing chronic diseases. Waist-to-height ratio as indicator of abdominal adiposity has been suggested as a better method of assessing obesity and overweight in children and adolescents (Weili et al, 2007; Hubert et al, 2008). This ratio has been suggested as a good predictor of obesity-related health risk and it can be used at the international level for all age, sex and race-ethnicity groups which is a major advantage (Ashwell & Hsieh, 2005). As cut-off point associated with a lower risk, the waist circumference should be less than half the height, which is simple to remember (McCarthy & Ashwell, 2006). In adults at least, results of a meta-analysis showed the superiority of measures of centralized obesity over BMI, especially waist-to-height ratio, for detecting cardiovascular risk factors (Lee et al, 2008). A study conducted among Chinese adults also showed that among the anthropometric measures of abdominal adiposity, waist circumference was better than waist-hip ratio or waist-to-height ratio (Wang et al, 2009). The relation between waist circumference and clinical outcome was shown to be consistently strong for diabetes risk, coronary heart disease, and all-cause and selected cause-specific mortality rates (Klein et al, 2007). Whenever feasible, therefore, BMI should be used with more specific measures of adiposity, such as the waist-to-height ratio, or else waist circumference, which reportedly allows the identification of children and adolescents at higher health risk (Must & Anderson, 2006), or else, skinfold thickness as a measure of adiposity and its distribution (see section 5.1).

Another limitation of BMI as indicator of obesity in childhood is that ethnic differences may account for variations in growth, body composition and maturation processes, as well as in tracking of BMI from childhood to adulthood; these differences are not fully captured by the existing criteria. In Asian adults, for instance, studies have shown that a similar BMI was associated with a higher adiposity level, and hence higher risk, compared to Caucasians. The BMI cut-offs for overweight and obesity were lowered accordingly for the Asian population (WHO, 2004).

3.2 Obesity trends and links with nutrition transition

Wang and Lobstein's (2006) comprehensive review of existent data at the time provided evidence for a growing global obesity epidemic among school-age children, with an estimated 10% carrying excess body fat. Their forecast was gloomy. In Europe, North America and parts of the Western Pacific region, 20-30% of children were overweight or obese. The lowest rates of obesity plus overweight were found in much of sub-Saharan Africa and parts of south-east Asia. North Africa, the Middle East and Latin America lied in between. In Africa, the estimated prevalence in 2010 was 8.5% (95% CI: 7.4%, 9.5%) and it is expected to reach 12.7% (95% CI: 10.6%, 14.8%) by 2020 (de Onis et al, 2010). The prevalence was lower in Asia than in Africa, but Asia was showing higher absolute numbers (18 million) of affected children. According to recent data by the World Obesity Federation on rates of overweight and obesity among school-age children by age, sex and WHO region[5], obesity alone ranged in 2014 from 0.9% to 1.2% in Africa, 7.2% to 13.3% in the Americas, 3.6% to 11.1% in the Eastern Mediterranean Region, 2.9% to 6.0% in Europe and 0 to 4.2% in South-East Asia.

These highly aggregated data conceal major differences within regions and within countries, however. Comparisons between populations are uneasy as they should take into account the criteria for overweight/obesity and cut-off values, the age-rage (pre-schoolers, school age children, adolescents), the year(s) of data collection, and the type of survey, whether one-time or repeat, cross-sectional or longitudinal.

In countries like Brazil, Argentina, Mexico, India and China, the prevalence of obesity among children and adolescents aged 5-19 was reportedly higher than 15% (Gupta et al, 2011; Gupta et al, 2012; Waters et al, 2011). In Latin America and the Caribbean, overweight and obesity ranged from 18.9% and 36.9% in school-age children (5-11 years) and from 16.6% to 35.8% in adolescents (12-19 years) according to a systematic review of studies conducted between 2008 and 2013. Overall, between 42.5 and 51.8 million children aged 0-19 years were affected (Rivera et al, 2014).

The velocity of increase of obesity in children is also of great concern. Wang and Lobstein (2006) published data on the annual rate of increase of overweight/obesity at school age, based on repeated surveys in 60 countries (approximately one third of WHO member countries). Obesity/overweight was increasing everywhere at school-age, except in some former Soviet Union countries. This confirmed the previous observations of high or increasing rates of overweight and obesity in children and adolescents in all developing regions (Labadarios et al, 2005; Sidhu et al, 2005; WHO, 2005; Abalkhail, 2002). The increase has indeed been higher in developing countries (+65%) than in developed countries (+48%) in the past two decades (NHS, 2009).

Countries such as Chile and Thailand are quite high on the list for the incidence rate. In Chile, for instance, the rate of overweight plus obesity at school entry doubled between 1987 and 2000, reaching above 25%. Obesity more than trebled over the same period (from 2% to 7%). Much higher rates of increase are observed in urban compared to rural areas, notably in China and Brazil. In China, overweight is a problem associated with urban living and high income, and adolescence (Wang & Zhang, 2002). In the Republic of Korea, the National Health and Examination Surveys revealed that among children aged 10 – 18 years, the prevalence of obesity more than doubled in three years (between 1998 and 2001): 5.4% vs 11.3 (Kim et al, 2006).

The relationship between obesity and income is very complex and there is a marked contrast in the dynamics of obesity in high- and low-income countries. Obesity is usually associated with poverty in high-income countries,

5 http://www.worldobesity.org/aboutobesity/resources/obesity-data-portal/resources/tables/19/

while it is still a marker of affluence in several low-income countries (WHO 2005). In childhood, obesity is also more prevalent in poorer groups of high-income countries, whereas it is more prevalent in better-off groups of low income countries. As economies develop in low-income countries, obesity shifts from better-off to poorer groups and ultimately spreads to rural areas (Monteiro et al, 2004). The relationship between family income and obesity in middle- income developing countries is not so systematic, but it tends to mimic that of developed countries, particularly in upper-middle income developing countries. In Chile, for instance, the prevalence of obesity among school girls was higher in schools of low socio-economic level of Santiago compared to schools of higher socio-economic level (Olivares et al, 2007). In this study, poorer school girls also had less physical activity. Although diet did not explain the obesity difference between socioeconomic levels, the consumption of energy-dense foods (fatty foods, ice cream, chocolate, French fries and snacks) was significantly associated with the presence of obesity, in the middle socio-economic level girls (Lera Marqués et al, 2006). The lower cost of energy-dense foods is one of the explanations for the link between obesity and poverty, in the USA (Drewnowski & Darmon, 2005). Healthier foods and diets were also reported to be more expensive in South Africa (Temple & Steyn, 2011).

Urbanisation and economic growth in developing countries are contributing to increases in obesity and related chronic diseases by fuelling the nutrition transition, a lifestyle transition characterized by shifts towards 'obesogenic' diets and sedentary lifestyles (Popkin, 2004). We talk of 'westernization/americanisation', particularly regarding dietary shifts. Traditional diets, which are usually high in fibre and low in sugar and fat, are giving way to highly processed, high-fat, high-sugar and low-fibre foods. Lifestyle changes also include decreasing energy expenditure because of mechanization of work and transportation. The low world prices for some items, in particular vegetable oils, is an important factor of this transition from traditional to westernized diets. Satellite television has also increased the demand for high-fat snack foods and fast foods in developing countries (Schneider, 2000). With a globalised food economy, the American food 'culture' pervades the whole world with cola beverages, fast-foods, and highly processed commercial items of high energy but low nutrient density. The only likely positive aspect of the dietary transition is perhaps the increased variety of diets. Dietary and lifestyle shifts typical of the nutrition transition are experienced by a growing number of people, even in poor countries. These shifts parallel those of obesity. They occur first among the better-off segments of the population, but soon spread to the whole population, at least in urban areas, as now observed in low- and middle-income countries.

A major challenge is to motivate people and facilitate retention of the best features of traditional eating patterns, and to address undernutrition without generating obesity. The optimal diet, that is, adequate and prudent (Vorster et al, 1999), lies somewhere in-between the traditional but inadequate rural diets, and the more varied but obesogenic urban diets.

3.3 The double nutritional burden: the coexistence of malnutrition and obesity

According to last estimates, overweight is more common globally than underweight[6]: while some 840 million people are undernourished, an estimated 475 million adults are obese and twice that number are overweight. The double nutritional burden is also present at national and household level; it needs to be addressed as it imposes a heavy toll on families, health systems and national economies.

The FAO (2006) identified three country profiles with regard to the double burden of under- and over-nutrition:

1. Underweight, reflecting acute malnutrition and stunting, chronic malnutrition, are high in children and adults; overnutrition is emerging. Typical countries with this profile are India and the Philippines;
2. Child stunting is high but underweight is declining in children; obesity and comorbidities are increasing in adults. South Africa is typical of this profile;
3. Stunting combined with overweight is observed in children while obesity and co- morbidities keep increasing in adults. Mexico, Egypt and China belong to this category.

6 http://www.worldobesity.org/aboutobesity/

With a rapid nutrition transition, both adult obesity and child underweight or stunting may be present in the same households. It was considered primarily a problem of middle-income countries up to recently (Garrett & Ruel, 2003; Doak et al, 2005); however, the phenomenon has also been observed in poor urban areas of low income countries such as Benin and Haiti (Bouzitou-Ntandou et al, 2005; Raphael et al, 2005). Based on 18 Demographic and Health Surveys conducted in middle and low-income countries, the co-occurrence of maternal overweight and child stunting was the more common type of double-burden household (Jehn & Brewis, 2009). In Brazil, 4% of stunted children were overweight. Longitudinal studies in Jamaica and Guatemala suggest that stunting in childhood increases the risk of abdominal obesity, but not of overweight, in later childhood or adulthood (Walker et al, 2002; Schroeder et al, 1999). The association between stunting in childhood and abdominal fatness, expressed as an increased waist-to-hip ratio, was more marked in women who had migrated to urban areas (Schroeder et al, 1999; Bosy-Westphal et al, 2009). Double burden households are not exclusive to urban areas. An underweight child and an overweight mother were observed in 11% of the households in rural areas in Indonesia and 4% in Bangladesh (Oddo et al, 2010). Future policies and interventions should address under- and overweight simultaneously in both rural and urban developing country settings (Kolcic, 2012), which poses new challenges to health professionals.

4. DETERMINANTS OF OBESITY IN CHILDHOOD: A LIFE-COURSE APPROACH

4.1 Critical periods in early life

There are critical periods in childhood for the development of obesity (prenatal life, early infancy, late infancy, adolescence) but the relative contribution of each is still not clarified. Small size at birth, and postnatal growth retardation in the first two years of life followed by rapid growth, have been associated with increased risk for adiposity and chronic diseases in later life according to the now accepted theory of developmental origins of chronic diseases (Barker et al, 2005; Delisle, 2005; Gluckman et al, 2008). The risk associated with size at birth follows a U-shaped curve, with both low birth weights and high birthweights (macrosomia) being associated with higher odds of obesity and co-morbidities later on in life. In China, a longitudinal study showed that, compared with infants of normal birth weight, infants with birth weight >4000 g, especially those above 4500 g, were at increased risk of adolescent obesity (Wang et al, 2009).

More and more studies show an association between chronic malnutrition in childhood and a propensity to subsequent obesity and hypertension, independent of fœtal malnutrition, or in addition to it. This association, illustrated by an increased likelihood of obesity with stunting, has been observed in several developing countries populations, including Mexico, Brazil, South Africa and Sénégal (Mukuddem-Petersen & Kruger, 2004; Boulé et al, 2003; González-Barranco et al, 2003; Bénéfice et al, 2001). As suggested by studies in Brazil, childhood malnutrition may predispose to obesity because of alterations in fat oxidation (Hoffman et al, 2000a, 2000b). However, in countries where stunting is no longer a problem, it appears that taller children may be at higher risk of obesity than normal height individuals (Cohen & Sturm, 2008; Stanojevic et al, 2007).

Data from the New Delhi birth cohort (Sachdev et al, 2005) and a review of 15 studies by Monteiro and Victora (2005) help to clarify the relationship between early growth and later adiposity. While higher birthweights are associated with higher adult BMI because of higher lean body mass, lower birthweights are associated with a higher percent body fat even though BMIs may be lower. High weight gain (>0.67 Z-scores) in infancy and early childhood (first 2-3 years) is associated with higher adult lean body mass, whereas high weight gain in later childhood and adolescence is associated with adult adiposity. However, gain in height, or linear growth, was not found to be associated with adult obesity. Thus, weight gain at different periods of early life may have differential effects on the acquisition of fat and lean mass. Further research is required to clarify the influence of foetal and infancy growth on chronic disease risk in different settings.

4.2 The role of infant feeding

In addition to growth patterns in early life, it is possible that infant feeding mode is related to later obesity. Breastfeeding appears to have a small but significant protective effect against obesity, according to a meta-analysis (Arenz et al, 2004), although this is still a debated issue. Furthermore, studies that have extended beyond school-age are still lacking. Li et al (2005) also reported that obese mothers who did not breastfeed were the most likely to have overweight children. Breastfeeding may decline with urbanization in certain developing countries, and another important factor is HIV-AIDS, for affected regions. However, in Latin America, breastfeeding was shown to increase in duration in both rural and urban areas (Pérez- Escamilla, 2003).

The protective effect of breastfeeding, if any, may be explained by the different composition of breastmilk and formulae, in spite of industry efforts. The composition of breastmilk is inimitable. Additionally, formula-fed babies tend to have higher intakes than breastfed babies, with a programming effect of the resulting stimulation

of insulin secretion, hepatic glucose output, and IGF-I. Breastfeeding may indeed promote better self-regulation of food intake than formula feeding (Fisher et al, 2000). Additionally, breastfed infants are exposed to flavours and odours of the maternal diet, which facilitates the transition to and acceptance of a wide range of solid foods (Mennella et al, 2001). Interestingly, breastfeeding was shown to be an independent predictor of fruit and vegetable consumption by pre-school children (Cooke et al, 2003). Various experimental and observational studies indeed suggest that there is an early programming or imprinting of eating patterns that are conducive to obesity. In rats, epigenetic programming by maternal behaviour was demonstrated (Weaver et al, 2004).

The early introduction of solid foods in the infant's diet, that is, in the first few months, was found to be associated with higher body weight in a few studies. Animal models of adult-onset obesity by early high carbohydrate feeds in neonatal rats have indeed been described (Srinivasan et al, 2003). A high carbohydrate formula in 4-day-old rats resulted in hyperinsulinaemia which persisted as long as the dietary intervention. The adaptations in the pancreatic islets are programmed and expressed in adulthood, and sustain hyperinsulinaemia as a basis for adult-onset obesity. The authors find it tempting to speculate that the changes in infant feeding (formula feeding, combined with the early introduction of infant foods such as cereal, fruits, juices, etc.) have contributed to the epidemic of obesity in USA and other countries.

The early introduction of sweet foods is associated with a strong preference for sugar. Infants given sweetened water during the first months of life show greater preference for sugar at two years than children not given sweetened water (Liem & Menella, 2002). Similarly, 6 year-old children whose mother had been adding sugar to their food later preferred sweeter juice or cereals. Sweet beverage intake is suspected of being a major factor of obesity in children in USA; it was also found to be negatively related to diet quality of young children, particularly in calcium and vitamin D (Marshall et al, 2005).

Obese mothers may nurture their infants/children into becoming obese adults. The study by Rising and Lifshtz (2005), using the metabolic chamber in California, showed that 4-6 month-old infants born to obese biological mothers ingested more energy, and a greater amount of energy from carbohydrates in complementary foods, than normal weight mothers' infants. Obese mothers also spent less time interacting with the baby prior to feedings and less time feeding the baby.

4.3 Eating and lifestyle patterns of children and adolescents

Parental attitudes toward feeding their children may impact overweight and obesity. In particular, restricting children's eating, overfeeding and pressure to eat have been associated with child weight gain (Rosenkranz & Dzewaltowski, 2008; Clark et al, 2007). As mothers are usually directly involved in planning their child's diet, they can influence food attitudes and practices among their young children (Berkowitz & Borchard, 2009). Faith & Kerns (2005) conducted a review of studies on parent feeding styles and their relationships with intakes and body weight in young children. They found that the strongest effect was that of restrictive feeding style on the part of the parents, which was associated with increased child intake and body weight. The influence of parents to foster positively or negatively lifestyle behaviours and the development of overweight and obesity among their children should not be underestimated (Scaglioni et al, 2008).

When there are no major economic or food security constraints, food choices of children and adolescents are primarily determined by cultural factors and the social and commercial environment. Adolescence is a time characterized by search for identity; struggle for independence from parental control and acceptance by peers; concern about appearance; vulnerability to commercial and peer pressure; and, limited concern for health (Spear, 1996). It is a good time for nutrition interventions (Delisle 2005). Some at-risk dietary patterns appear quite common among adolescents, at least in industrialised countries, and to mention a few: snacking, usually on energy-dense foods; meal skipping, particularly breakfast, or irregular meals; wide use of fast-foods and sweetened drinks; low consumption of fruits and vegetables, and of dairy products in some instances; and, faulty dieting practices in girls (Franko et al, 2008; Johnson et al, 2008; Ebbeling et al, 2007; Yamamoto et al, 2005; Berkey et al, 2003; Sjöberg et al, 2003; Ludwig et al, 2001; Cavadani et al, 1999; Neumark-Sztainer et al, 1999).

The WHO survey of school-aged children in Europe showed that over 30% of 15 year olds did not have breakfast on regular school days and over 25% drank sugar-containing soft drinks daily (Currie et al, 2004). In other studies on diets of adolescents in Europe, it was found that eating fast-foods and skipping breakfast are eating patterns that were associated with higher BMI (Moreno et al, 2005). Deshmukh-Tasker et al (2010) found a significantly higher prevalence of obesity in children and youth who missed breakfast. This observation was confirmed by other authors (Nieman & LeBlanc, 2012). In Chile, Olivares et al (2004) reported that approximately 500 kcal of school girls' daily energy intake came from processed foods and sweet beverages. Soft drink consumption among youth is increasing at alarming rates (French et al, 2003), with greater consumption reportedly being associated with increased rates of weight gain and obesity (Warner et al, 2006; Vos & Welsh, 2010; Libuda & Kersting, 2009; Gibson, 2008; Harrington, 2008), although the evidence is inconclusive for some authors (Bachman et al, 2006; French & Morris, 2006; Pereira, 2006).

A study conducted among school-children in urban Algeria illustrates the dissemination of western-type dietary patterns that are conducive to obesity (Oulamara et al, 2006). Compared to normal-weight children, the overweight/obese had similar energy intake but they skipped breakfast more frequently, they drank less milk, they had a higher percent of energy from protein, they had a higher fat intake (only in boys), and they more frequently snacked on high-carbohydrate, high-fat foods, often in front of the TV. In Nepal, a study among school children revealed that 'fast-foods' (ready to eat snacks, chips...) were preferred by more than two-thirds of those surveyed, and that advertising influenced preferences in 80% of them (Sharma, 1998). Although fast foods and sweet soft drinks, which have been incriminated in the childhood obesity epidemic, did not appear very important in children's diets of developing countries at least up to a few years ago (Adair & Popkin 2005), this may be changing rapidly with globalisation.

The pervasive influence of commercial marketing of food on children's preferences and obesity is now recognized (Boyce, 2007). As described in a report to the US Federal Trade Commission (Platt Majoras et al, 2006), traditional advertising in television and print media is but one method of marketing food to children. The use of other marketing techniques such as promotional efforts like contests, product placement in movies and video games, licensing of popular children's characters, sponsoring of special events and in-school activities appears to be increasing. Food marketers also reach children through packaging and labelling.

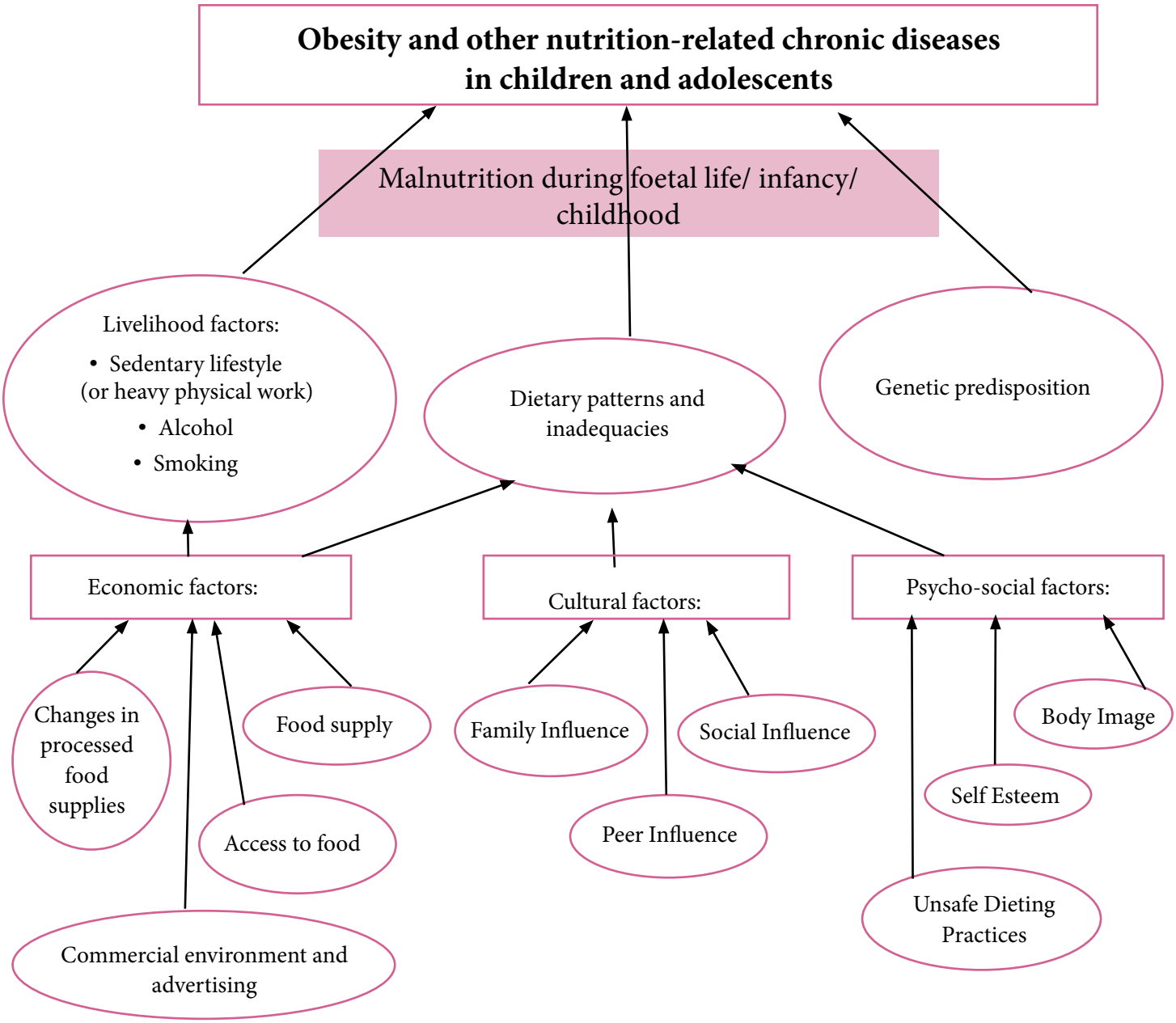
In a report by the Institute of Medicine Committee on Food Marketing and the Diets of Children and Youth (McGinnis et al, 2005), it was noted that food and beverage products marketed for children and youth are typically high in total calories, fat, sugar, salt, and low in other nutrients. It was also concluded, from a review of several studies (Proctor et al, 2003; Crespo et al, 2001), that television advertising is associated with increased rates of obesity in USA, with impact stronger in children than in youth. The influence of advertising on food preferences, purchases and consumption among children is a concern in the USA and in Europe, and it is a growing concern alos developing countries, particularly in cities. Little information is available in the Latin American, African or Asian context, however. The importance of this issue commands much more research and evidence-based action.

Physical inactivity is another factor linked with obesity in children and adolescents (Patrick et al, 2004). Moore et al (2003) showed that children who spend less time in moderately vigorous activity are at higher risk to become obese during childhood and adolescence. In middle and high income groups, physical activity tends to fall during adolescence (Dinger & Waigandt, 1997) with girls being less active than boys (Robinson & Killen, 1995). In Lebanon, where some 30% of adolescent boys and 13% of girls are overweight or obese, it was found that children and adolescents who did not exercise were over twice more likely to be obese than those who did (Hwalla et al, 2005). A systematic review of physical activity in children and youth estimated an increased risk of 33% of becoming overweight or obese in the least active group as compared to the most active group (Janssen & Leblanc, 2010). In contrast, in poorer societies of developing countries, adolescents may be expected to engage in heavy physical work on a daily basis, as reported for boys and girls in Malawi (Fazio-Tirrozzo et al, 1998) and for girls in Senegal (Benefice et al, 2001). These factors influence energy requirements and subsequently weight status. Life conditions may impose high physical work and energy demands among rural poor adolescents, while sedentary lifestyles are increasingly observed with urbanisation even in low income countries.

Children who spend more time in front of the screen are at higher risk of obesity, according to a review by the Kaiser Family Foundation (2004). Although screen time was not correlated with physical activity, its effects may be mediated by encouraging nibbling and by the advertisements of poor food choices. In the North American context, having a television set in their bedroom placed children at higher risk for obesity (Adachi-Mejia et al, 2007). Interventions to curb screen time were found to be successful in reducing childhood obesity (see section 8.3).

A conceptual framework of obesity and other nutrition-related chronic diseases in children is illustrated in Figure 1. This model depicts psychosocial, cultural and economic factors that may contribute to dietary inadequacies and obesogenic lifestyles. Foetal and early life factors are in the background.

Figure 1. Conceptual framework of obesity and other nutrition-related chronic diseases in children and adolescents (Delisle 2005)



5. METHODS FOR THE ASSESSMENT OF OBESITY, DIET AND PHYSICAL ACTIVITY

This section includes a description of the anthropometric, dietary, and physical activity measures to assess obesity and its major determinants, as well as to evaluate programme impact.

5.1 Anthropometric methods to assess obesity

Several anthropometric methods are available to assess obesity in children and adolescents, and there is considerable variation among them in terms of 'essentiality', cost and complexity. Two categories are defined in order to help select the appropriate methods according to funding available, in addition to specific objectives of programmes: basic measurements, and additional ones. Details on measurements are provided in Appendix I. The most commonly used approaches for population health surveillance of children and adolescents are body mass index (BMI)-for-age and sex, measures of skinfold thickness, and measures of girth, such as the waist, hip or neck circumference (Public Health Ontario, 2013).

5.1–1 Basic measurements

Weights and heights, along with actual age (and sex), are essential information from which various indicators can be developed, including BMI. Sets of reference data and cut-off points to assess overweight and obesity in school-age children and adolescents based on weights and heights were already presented, and their limitations discussed (section 3.1).

Indicators of total body fat, and of body fat distribution are also very important, in addition to BMI. For one, obesity is defined as excess body fat and BMI does not distinguish lean and fat body mass. Additionally, fat distribution is even more important than BMI alone as a determinant of cardiovascular risk factors, as reported at least in the adult population. BMI-for-age has been recommended as the most appropriate indicator of overweight and obesity in children and youth, and usually sufficient for surveillance purposes (Krebs et al, 2007; Himes 2009). The additional measurements that can help to assess body fat and its distribution described in the following section may be useful for research purposes or when screening focuses specifically on risk factors for cardiovascular disease or diabetes (Himes 2009).

5.1–2 Important additional measurements

The least expensive indicator of fat distribution is undoubtedly the waist circumference. The measurement is designed to capture information regarding abdominal (or central) distribution of body fat. Increased levels of abdominal body fat have been linked to increased health risks in both children and adults (Katzmarzyk et al, 2004). However, no standard cut-off points are as yet available to determine the health risks associated with various waist circumference measurements in children and adolescents, and the few studies conducted indicate that they are at variance with BMI categories (Invitti et al, 2006; Must & Anderson, 2006). Studies conducted in China determined the 90th and 84th percentiles for Chinese boys and girls respectively, as cut-off point for waist circumference to predict cardiovascular risk factors (Liu et al, 2010; Yan et al, 2008). Measuring waist circumference should nonetheless be given consideration since there is increasing evidence for an association between fat distribution and health risks in children and adolescents. It was found to be the best single predictor of abdominal fat in children and adolescents; equations to compute abdominal fat from waist circumference were derived (Brambilla et al, 2006). Furthermore, waist circumference appeared predictive of insulin resistance in children in widely different settings, namely Iceland and Argentina (Thorsdottir et al, 2006; Hirschler et al, 2005). The waist-to-height ratio is also a useful yet simple indicator of abdominal adiposity, although it may

require further validation in school-age children and adolescents. This ratio may be applicable to adults as well as children, to male or female subjects, and to different ethnic groups. The suggested cutoff value for the waist circumference-to-height ratio is always 0.5, which makes it easy to use (McCarthy & Ashwell, 2006). This ratio is a valid indicator of abdominal obesity: it was found superior to BMI, and comparable to waist circumference and waist-hip ratio for prediction of coronary heart disease incidence among middle-aged and older women (Page et al, 2009).

Skinfold thickness measurements can also provide useful information on subcutaneous body fat and its distribution. Measurements of skinfold thickness are generally more highly correlated with total body fatness than BMI-for-age (Freedman et al, 2005; Kuczmarski et al, 2002). This is the rationale for measuring skinfolds as indicators of overweight and obesity. It is important to distinguish between high body weight due to a high lean body mass (from bone and muscle mass) and the same body weight due an excess fat mass. In the Quebec Child and Adolescent Health and Social Survey (Ledoux et al, 2002), for example, using BMI measurement alone led to an overestimation of obesity, as a high BMI was often due to a high lean body mass and not excess body fat. Adding measures of fat distribution – i.e., triceps and subscapular skinfolds – reduced the rate of obesity, as illustrated in Box II. Therefore, coupling measurements of BMI-for-age and of fat mass or distribution may significantly improve the ability to predict the risk of developing chronic diseases in adolescents.

Box II. Skinfold thickness as a complement to BMI to detect obesity

In the Quebec survey (Ledoux et al, 2002), the rate of obesity defined as BMI above the 95th percentile for this population alone was higher than when in addition to a high BMI, skinfolds were considered: triceps skinfold above the 95th percentile AND subscapular skinlfold above the 90th percentile.

Age and sex	% obese (BMI alone)	% obese (high BMI + high skinfolds)
Boys, 9 years	34.5	27.7
Girls, 9 years	32.1	24.1
Boys 13 years	31.1	21.4
Girls 13 years	32.5	23.6

Single skinfolds are appropriate in children/adolescent surveys, with quality control monitoring. However, there is no general agreement as to the best single skinfold to use as an index of body fat, as it is not the same for all ages, ethnic groups, and for boys and girls. Triceps and subscapular skinfolds are the most common, and centile values for boys and girls based on data collected in US children of all races in 1971-1975 are available (Gibson, 1990). Other skinfold sites have been used in children and adolescents, including calf and suprailiac measures (Heyward & Wagner, 2004).

Based on skinfold measurements, some equations to estimate % body fat have been validated in African-American and Caucasian children and adolescents; charts on percent body fat corresponding to the sum of two skinfolds (triceps + subscapular or triceps + calf) may be used for boys and girls aged 8-17 years (see Heyward & Wagner, 2004). The following box provides the classification of percent body fat based on the sum of triceps and subscapular skinfolds.

Box III. Skinfolds according to range of percent body fat (adapted from Heyward & Wagner, 2004)

% Body Fat	Sum of triceps + subscapular skinfold	
	Boys (mm)	Girls (mm)
Optimal range ~ 11%-19% boys; 15%-25% girls	13-22	15-27
Moderately high ~ 19%-25% boys; 25%-30% girls	22-29	27-35
High ~25%-31% boys; 30%-35.5% girls	29-39	35-45
Very high > 31% boys; > 35.5% girls	> 39	> 45

Limitations of skinfold measurements are that the required callipers are quite expensive and the technique needs to be monitored on a regular basis for quality control. A second measurement performed by a supervisor (nurse, nutritionist…) on every tenth individual is highly recommended.

Bioelectrical impedance analysis (BIA) allows the estimation of body fat and lean body mass. It measures the rate at which a small electrical current flows through the body (Insel et al, 2001). Two principles underline this method (Heyward & Wagner, 2004). Firstly, biological tissues act as conductors or insulators and the flow of current through the body will follow the path of least resistance. Secondly, impedance is a function of resistance (a measure of pure opposition to current flow through the body) and reactance (the opposition to current flow by the cell membrane). Fat resists or impedes the electrical current. Appendix II describes BIA measurement. Based on data from over 3,000 children aged 5-18 (Williams et al, 1992), boys are classified as "obese" if their body composition contains 25% fat; the cut-off is 30% for girls. However, many factors need consideration for a reliable measure of body composition using BIA, which can be performed only when the environmental conditions can be sustained throughout the survey. For this method, high environmental temperature, insufficient body hydration, physical exercise, and menstrual cycle are some sources of measurement error. These factors may limit the use of impedance for the assessment in some specific settings. Furthermore, good quality equipment may be costly and regular technical support is needed. However, there are now on the market reasonably-priced precision scales that measure BIA and provide in one-step process body weight and % body fat. With the introduction of simple lower-body BIA assessments that just require that the child step on scales with electrode foot plates, BIA has become increasingly popular. Nevertheless, some models of the lower-body BIA apparatus only provide the summary measure of percentage body fat, and the details of the resistance, reactance, equations, or the referent population are not available. The equations are appropriate in a particular population (Himes 2009).

Freedman et al (2005b) recommend differentiating fat-free mass and fat mass, in children and adolescents. A simple way may be to refer to the body fat reference curves developed for UK children and adolescents on the basis of BIA (McCarthy et al, 2006). Tables provide % body fat centile values by exact age, for boys and girls aged 5-18 years; 'excess body fat' and 'obesity' suggested cut-offs are the 85th and the 95th percentiles, respectively.

The following box lists the anthropometric measurements by decreasing order of essentiality and feasibility in field assessment of obesity in childhood.

Box IV. Ranking of anthropometric measurements for the assessment of obesity in school-age children and adolescents in developing countries

- Weights, heights and age (IOTF or WHO reference values for BMI forage and sex)
- Waist circumference or waist circumference-to-height ratio (cut-off 0.5) as indicator of abdominal adiposity
- Skinfold thickness: subscapular, triceps (Centile reference values from US data)
- % body fat, using bioimpedance analysis (Centile reference values from UK data)

For a more accurate assessment of obesity in adolescents, the changes in body composition normally occurring at puberty would have to be taken into account. This can be assessed using a questionnaire based on Tanner's stages of puberty (see Appendix III for an exemple), if culturally acceptable. The adolescents can then be grouped in two categories – those having and those not having reached puberty. This is not routinely done in all surveys, however.

5.2 Dietary assessment

The principal tools to appraise eating patterns, dietary intakes and diet quality are described, following some remarks on specific issues in children and adolescents.

5.2–1 Issues in children and adolescents

There is increasing interest in determining what and how young people eat because of the emerging association between adult chronic diseases and the diets of children/adolescents. In order to foster healthy eating among children and adolescents, it is important to assess food consumption patterns and the various factors influencing them, beyond energy and nutrient intakes. In many instances, exploring food patterns in a qualitative manner may even be sufficient for the purpose of identifying the need for eating behaviour modification, and for developing appropriate strategies for the prevention of obesity. Yet the collection of quantitative dietary intake data may be important, notably to monitor long-term dietary changes in relation to chronic diseases, as well as to micronutrient deficiencies. However, getting accurate dietary data on children and adolescents is a challenge. Misreporting was shown to be a major problem in dietary surveys of children and adolescents in a project on dietary intake and status across Europe (Lambert et al, 2004). In Santiago (Chile), for instance, it was found that around 25% of low-income children in the 4th grade (age 8 years) had difficulty in understanding a food questionnaire, mostly because of poor reading skills; the proportion fell to 10% among 10-12 year-old children (Ivanovic et al, 1992). In a review on issues in quantitative dietary assessment of children and adolescents, it was reported that children can reliably report their food intake without their parents by the age of 8-10 years, but that they have difficulty in reporting portion sizes, and that the recall period should not extend beyond 24 hours (Livingstone et al, 2004). Furthermore, the same review states that underreporting of food intake is more of a problem in adolescents, as well as in overweight subjects. In the CATCH study in the United States (Child and Adolescent Trial for Cardiovascular Health), incorporating parent information with the self-reported intakes of seventh graders (around 13 years of age) had only a small effect on mean nutrient intakes (Garceau et al, 1999). Yet the often irregular eating patterns of adolescents may hinder the accurate assessment of their usual dietary intake (Moreno et al, 2005). Consequently, quantitative dietary data on children and adolescents if deemed necessary should be interpreted with great caution as it is prone to reporting error, even more so than in adults.

5.2–2 Quantitative dietary assessment

Full dietary assessment requires quantitative measurement of food consumption and nutrient intakes. A concise and excellent summary of field and laboratory methods for the measurement of dietary intake is provided by Rutishauser (2005); the difficulties and limitations are also highlighted. It is all too well known that individual food intake is not static; it varies both in types and amounts of foods from day-to-day, week-to-week, and possibly also, from one season to the other, depending on the context. Therefore, a bare minimum of 2 days of intake measurements, preferably non-consecutive (using a 24-hour food recall, or a food intake record), on the same individual, and a third day on a subsample, is required to assess the adequacy of energy and nutrient intake,

irrespective of the age category and of the setting. For example, in the Quebec Child and Adolescent Health and Social Survey (Ledoux et al, 2002) as well as in the surveys in 5 francophone countries (France, Belgium, Tunisia, Switzerland and Quebec-Canada), a 24-hour recall was repeated 3 times in a subgroup of the study population, i.e., once every week for 3 consecutive weeks, alternating days to ensure that every day of the week was covered (Lorenzo, 1999). In addition, the multiple-pass method should be used for enhancing the accuracy of 24-hour recalls (Blanton et al, 2006). A detailed description of a 24-hour recall methodology is given in Appendix IV.

Even if diets are more monotonous in certain developing country populations, there is a need for more than one day of recall or record in order to assess intra-individual variability (Harrison, 2004). For assessing the relationship between nutrient intake and health status, intake over a longer period, for instance the previous month, and even the previous year, is required. Methods used for this purpose are primarily food frequency questionnaires, and can usually provide only semi-quantitative information, based on usual serving size of food items.

There is always error in dietary measurements. This does not preclude the usefulness of such measurements, but the type of error should be taken into account in interpreting the data. Basically, there are two types of error in dietary measurements: random and systematic. While random error can be reduced by extending the period of observation, this is not the case for systematic error, which leads to bias in the intake estimates. Systematic error is not randomly distributed; for instance, under-reporting of intake is notoriously higher in obese than normal-weight people. As noted by Harrison (2004), there is evidence, although limited, of less under-reporting in developing country settings. Three measures are widely used to assess the validity of dietary assessment: urinary nitrogen as a marker of protein intake, energy expenditure measured by doubly labelled water to compare with energy intake in individuals with stable weight, and the ratio of energy intake to basal metabolic rate (BMR) to identify plausible records of food intake. Obviously, these methods are seldom feasible in the field because of the cost and the need to access sophisticated equipment, except for the ratio of energy to BMR, which is calculated from height and weight. If the ratio of energy intake/(BMR X 1.55 [for light physical activity]) is lower than 0.76, under-reporting may be suspected, and over-reporting when this ratio exceeds the Goldberg cut-off of 1.24 (Black, 2000). However, this method is more applicable to populations than individuals, and information on physical activity is required to use an adequate physical activity level (PAL), as 1.55 may not be appropriate in instances where physical activity level is high.

Whatever the measurement method used, whether based on recording or recall, the same basic steps are involved, that is: precisely identifying the foods/beverages; estimating the frequency and/or amount; and calculating intake with food composition tables. Both record and recall methods may provide quantitative data.

Record methods may be self-administered or administered by an interviewer who would then weigh and record everything eaten by the target individual(s) over a period of a few days. Food weighing methods are better suited to household than individual food consumption surveys and they are still quite widely used in developing countries, but they are usually in the hands of an interviewer. Methods based on recording are demanding and there is a risk of error particularly when several meals are eaten away from home, which is often the case in cities. Additionally, in population groups with a high rate of illiteracy, food recording poses problems, unless school children can do it for other family members.

Recall methods can be quantitative, semi-quantitative or only provide consumption frequency, or even more simply still, only provide information in terms of eating or not eating a given type of food during a reference period. Recall methods are much more practical than record methods, particularly in population groups with a high rate of illiteracy. The food frequency questionnaire and 24-hour recalls are the most widely used recall methods. While the 24-hour recall is usually intended to compute current amounts of foods and nutrients consumed per day, food-frequency questionnaires are not normally designed to obtain quantitative information on intakes, at least not across the whole range of food groups and nutrients. As the name implies, the aim is to assess the frequency with which certain food items or groups are usually consumed over a reference period – daily, weekly, monthly….

The choice of a dietary assessment method depends among other factors on the context, the purpose of the assessment, and whether it is at the population or individual level. It has been suggested that the use of food-frequency questionnaires be restricted to providing information on the long-term intake of a limited number of foods or food groups rather than to use them to derive quantitative estimates of nutrient intakes of individuals (Rutishauer, 2005). For instance, food frequency questionnaires are well suited to identifying the risk of inadequate intakes of those nutrients that are concentrated in a relatively limited range of foods, such as vitamin A, vitamin C, iron and zinc. However, quantitative estimates of nutrient intakes of individuals are quite common in epidemiological studies examining the link between dietary intakes and the risk of chronic diseases such as various types of cancer, and other nutrition-related chronic diseases. Estimating portion size is a challenge; various visual aids can be used, including food models, pictures, and local containers and kitchen utensils. An additional issue is individual portion size estimation when meal partakers eat from a common bowl.

Food frequency questionnaires include lists of food items which may be more or less extensive, depending on the setting and the suspected dietary inadequacies or imbalances, and on the objectives of the study. For instance, a study may want to examine total fat and fatty acid intakes; specific micronutrients (vitamin A; iron; zinc); or the intake of specific food groups such as fruits and vegetables.

Specific dietary instruments have been developed for adolescents in the United States and Europe (Rockett et al, 2003). Among these are short food-frequency questionnaires to assess, for instance, consumption of fruits and vegetables, and fat. Another interesting instrument is a modified food frequency questionnaire with picture cards for individual foods and drinks which was developed and validated in low-income, overweight African-American adolescent girls. Additionally, the 'Youth Adolescent Questionnaire' (YAQ) based on reported food frequency has been designed to improve the assessment of adolescents' diets in large epidemiological surveys. In several ethnic communities in California, the dietary patterns as assessed with the YAQ did account for differences in ethnicity, income, and education levels. The instrument also reportedly provided a good estimate of mean energy intake.

Appropriate and complete food composition data bases are required for adequate estimation of intakes. These are seldom available in developing countries, in spite of recent developments through INFOODS, the International Network of Food Data Systems created in 1984 and now under the auspices of FAO and its originator, the United Nations University[7].

The ideal food composition table for use in developing countries would:

- include all locally important foods and beverages;
- provide complete nutrient information;
- include composition data on foods 'as acquired' and 'as consumed';
- allow food-based analyses and allow the linkage of ingredients through recipes to mixed dishes;
- and be accompanied by a flexible and affordable software system (Harrison, 2004).

5.2–3 Dietary diversity and other diet quality indices

A useful approach to assessing individual's diet is through diet quality scores. The healthy eating index (HEI) as developed by the US Department of Agriculture (USDA) is an example, but there are several others. The HEI score can range from 0 to 100. It includes 10 dietary criteria: grain, vegetables, fruit, milk, meat, total fat intake, saturated fat intake, cholesterol intake, sodium intake, and food variety. For example, an individual who consumes 2-3 servings of fruit would obtain a score of 10 for the fruit component. In the USA, a lower HEI was associated with increasing odds of obesity, after adjusting for socio- demographic and lifestyle factors (Guo et al, 2004).

7 www.fao.org/infoods

A promising and yet simple composite measure of diet quality is the diet diversity score (Arimond & Ruel, 2004).

It is all too well known that a good diet is a varied diet. The method does not require quantitative estimates of foods and beverages, or the use of food composition tables. All that is needed is an appropriate list of foods/drinks to propose to respondents, who will then identify those consumed over a reference period. A score is then constructed by summing up the 'positive' food groups. This method has been used in developed (Kant, 1996) and developing countries (Savy et al, 2005; Torheim et al, 2004), and it has been validated against quantitative dietary assessment methods, as well as against health outcomes in various settings. Dietary diversity was also found to be a useful indicator of household food security in developing countries (Hoddinot & Yohannes, 2002).

There are caveats, however, as no international guidelines have been defined for the number (and nomenclature) of food groups, for score cut-offs for low diversity, and for the advisable reference period (Arimond & Ruel, 2004; Ruel, 2002); FAO/WHO/IFPRI, 2004). Most studies have used as reference recall period a single or repeat 24-hour period, or the previous week, as we did among mothers in Haiti (Raphael et al, 2005). The number of food groups varies widely, and may depend upon local eating patterns, as well as critical food groups from a nutrition point of view (for instance vitamin A-rich vegetables and fruits; whole-grain cereal products; sweets; high fat snacks…). The number of food groups ranges, according to the literature, from as few as 4 to more than 20 groups. In a workshop held at FAO in 2004 (FAO/WHO/IFPRI 2004), it was suggested to use a 9-group basic classification. These food groups are listed in Box V.

Box V. Suggested food categories for the assessment of dietary diversity (FAO/WHO/ IFPRI 2004)

- Cereals, roots and tubers Legumes, seeds and nuts
- Vitamin A-rich fruits and vegetables
- Other vegetables
- Other fruits
- Meat poultry and fish Eggs
- Milk and dairy products Fats/oils

The assessment of dietary diversity may be particularly appropriate for school-children and adolescents, when coupled with information on eating patterns. Higher food diversity may reflect a better nutrient adequacy; it may however be associated, in certain settings, with a higher energy intake, as suggested by a report from Iran (Mirmiran et al, 2004) showing that in subjects aged 10 to 18, a more diversified diet was associated with a higher BMI. We showed in Mexican men that a higher food diversity score was associated with a less healthful diet (Ponce et al, 2006). More research is needed on the food groupings and on the relevance of including food consumption frequency (or portion sizes).

5.2–4 Assessing eating patterns and habits

The purpose is to document not only what young people eat, but also where, how, how many meals/snacks, with whom, whether they take food supplements, engage in dieting, etc. This knowledge of eating patterns is essential for any kind of intervention aimed at eating behaviour modification. Among other things, it may help to identify dietary transition trends, based on typically urban or Western eating practices/foods. The following box lists various items to investigate regarding the eating patterns of adolescents.

Box VI. Issues related to eating patterns

- Types of foods eaten and frequency of eating
    - In restaurants
    - At traditional eateries
    - On the street
- Types of foods eaten between meals
- Pocket money used to buy food, and type of food purchased
- Types of foods eaten at meals served at home
- Types of meals served at home, and their respective frequency
- (i.e., easy-to-prepare, frozen products, canned products, store bought, delivered from restaurants)
- Family members who prepare the meals
- Family members present at meals
- List of foods (up to 20 ± foods) by order of importance eaten at meals; between meals.
- Eating before going to school and type of foods eaten at breakfast
- Frequency of engaging in dieting practices.

5.3 Physical activity assessment

As a sedentary lifestyle may be a key factor in obesity among young people, the enquiry would be incomplete without at least an attempt to appraise the level of physical activity. There are various methods, but the 24-hour recall, similar to that for food intake, appears promising. Once the activities for the main occupation, leisure and transportation have been identified, and their intensity and duration noted, it becomes easy to identify those subjects who are inactive, those who have some physical activity, but below the level recommended by WHO, and those who may be considered physically active. It is recommended that children and adolescents engage at least 60 minutes per day in moderate- to high-intensity physical activity[8]. Other methods include the use of a table of discrete physical or sport activities, with space to register the frequency over the reference period (previous week, month, trimester, year.…). This is the approach used in the Quebec Survey on Physical Activity and Health (Nolin et al, 1998). A validated questionnaire based on a similar approach was used for adults in Cameroon (Sobngwi et al, 2001); it could be adapted for children. This method may not be as easy to use as the 24-hour recall, since a rather exhaustive list of locally-relevant physical activities of young people must first be developed. The level of energy expenditure corresponding to the activities needs to be ascertained in order to assess the amount of time spent on average in moderate or vigorous physical activity. The energy cost of activities is expressed in metabolic equivalents (METs), which is the ratio of the working metabolic rate divided by the resting metabolic rate. Tables on the energy expenditure by types of activities are available (Ainsworth et al, 1993). Any activity representing an expenditure of 3-5.9 METs is considered moderate intensity, whereas vigorous physical activities represent 6 METs and above.

A potentially very useful tool is the global physical activity questionnaire (GPAQ) developed by WHO for physical activity surveillance in countries[9]. Information is collected on physical activity for work, for transportation and for leisure, as well as on sedentary behaviour, that is, time spent daily sitting or reclining (excluding sleep). When investigating physical activity among school-age children and adolescents, the questionnaire needs to be adapted, particularly as regards 'work'. Three subcategories of 'work' need to be included, physical activity as part of the curriculum in school, for chores at home (or at school), and eventually for paid work.

There are few studies regarding the methodology used to validate the accuracy of questionnaires to assess physical activity in adolescents. Aaron et al (1995) using the Youth Risk Behavior Survey of the Centers for Disease Control developed a past week questionnaire administered four times during school year to 12 – 16 year-old males and females attending high school in the Pittsburg area. The study population was of diverse racial origin: 73% Caucasians, 24% African Americans and 3% Hispanics or Asians. The questionnaire was adapted from

8 http://www.who.int/dietphysicalactivity/physical-activity-recommendations-5-17years.pdf?ua=1
9 www.who.int/chp/steps

the Minnesota Leisure Time Activity Survey used in many epidemiological surveys. Students had to record frequency and duration of all leisure-time activities they had participated in at least 10 times over the past year as well as school- sponsored athletic team activities. This yielded an overall time for physical activity (hours/week) for each activity, that was then multiplied by the metabolic cost of the activity (METs). Specific attention was also given to time spent in vigorous physical activity. Other measures of physical strength and fitness were used to validate the level of fitness of each student for comparison with answers to the questionnaire. The estimates of physical activity obtained from the past year questionnaire completed at the end of the study were significantly correlated with the reference method (average of four past week questionnaires). Therefore Aaron et al suggested that the past year questionnaire is an adequate reflection of the habitual physical activity levels of adolescents. If the level of total activity is of interest, occupational activity as well as means of transportation should be added to the questionnaire. The authors suggest that the questionnaire can be easily modified to reflect leisure-time activities or to provide an accurate estimate of habitual physical activity level of adolescents.

In settings where television and Internet are widely accessible, the average number of hours spent per week in front of the screen may also be used as an index of a sedentary lifestyle. This index was found to be positively related to overweight and obesity in several studies and setting, including among Cree children and adolescents of Canada(Bernard et al, 1995).

Other methods of assessing physical activity include motion sensors, such as pedometers, actometers and accelerometers. Accelerometers reflect walking and running very well but are not sensitive to other common types of physical activities because they are measuring acceleration on a vertical plane. Three-dimensional accelerometers correlate better with energy expenditure but need more validation in children and adolescents. Heart rate monitoring provides a good general index of moderate- or high-intensity activity but there are many confounding factors at low-level of physical activity.

Doubly-labelled water is the most accurate method for the assessment of physical activity, but is not practical due to its high cost and technical complexity and therefore, it cannot be used in epidemiological studies (Molnar & Livingstone, 2000).

As done in a study on rural school children in the USA (Walker et al, 2005), field assessment of physical activity may include the following environmental elements as appropriate, in addition to physical education type and time in school, and sedentary activities (television, video games, computer):

Indoor and outdoor facilities for physical activity in schools

Local availability of parks, recreational areas

Access to school facilities for physical activity after school

Parental involvement in how children spend free time.

For physical activity as well as for dietary patterns, individual behaviours are strongly dependent upon the environments, whether or not they are conducive to healthy lifestyles. Whilst behaviour change strategies are essential if overweight and obesity are to be prevented during childhood and adolescence, the environment has to be such that healthy behaviours are available, accessible and pleasant.

6. BEHAVIORAL CHANGE MODELS: DESCRIPTION AND APPLICATIONS

This chapter describes some widely known behaviour change models and provides practical hints to their use in obesity prevention programmes targeting school-children and adolescents. Such programmes need to go beyond individual behaviours, using an ecological approach to modify the physical and social environment as a means of influencing individual behaviours. Therefore, the models presented here could have been discussed in chapter 7, which addresses programme planning. However, behaviour changes models are kept separate for two reasons. First, one goal of obesity prevention is to bring about behavioural changes at the individual level. Second, it is important for health and nutrition education programmes, including obesity prevention programmes, to be grounded in an appropriate model in order to be effective. Health and nutrition professionals, however, should be cautious when combining or applying various theoretical frameworks. They are warned not to simply 'pluck' constructs from divergent theories and string them together for the purpose of theoretical integration (Bandura, 1995). Serious reflection is needed when using such models.

6.1 Challenges of changing behaviour

What makes people change their behaviours to improve their health is a question which has perplexed health professionals over the past decades. It is also one of the greatest challenges we face in trying to deal with the obesity pandemic. The first step is to identify what people eat. The second is to identify which factors influence their food choices. The third is to identify which factors will foster change in food choices. The same applies to physical activity, the second component of the weight control equation.

What do children/adolescents eat?

It is important to determine what children/adolescents eat in order to identify problem eating behaviours related to the specific health issue under study. This will vary from region to region. National nutrition surveys are useful but information on local habits is essential (see chapters 5 and 7 on how to conduct assessments). In a review of eating patterns related to obesity among youth, the following behaviours have repeatedly been associated with overweight and obesity: frequent snacking on high-energy foods, high consumption of fast-foods and sweetened beverages, skipping meals, and low consumption of fruits and vegetables (Delisle 2005; Delisle & Strychar, 2006).

What influences children/adolescents' food choices?

In both developed and developing countries, food choices are a function of individual, economic, environmental and cultural factors (Delisle & Strychar, 2006; Raine, 2005), influenced by the genetic, physiological and psychological state. The relative importance of these factors will vary depending on the country or region. Therefore, a crucial step is to identify predominant factors in a given region in order to provide useful information in planning local obesity preventive initiatives (see section 7.2 on how to conduct the assessment). These factors can all influence food choices at meal time or between meals. Rosen (2002) states that what one eats is dependent on the degree of hunger, the amount and type of food available, the taste of the food, the cultural rules regarding what to eat and when to eat, the social setting, the amount of time available for eating, other activities taking place when eating, and past experiences of eating certain foods. Children/adolescents decisions on what to eat, how much to eat and how frequently to eat is partly dependent on the family's socio- economic status, social and cultural norms, household food availability, household meal patterns and family members' food preferences. Peers, friends and significant adult models, including teachers, become more and more influential on diets as children grow older.

What influences result in improved food choices by children/adolescents?

Behaviour change models provide practical information for understanding dietary behaviours and how to influence change. Three theoretical perspectives are presented. They were selected, among others (Glanz et al, 2003), because they can be useful to study and prevent obesity. They include the Health Belief Model, the Theory of Planned Behaviour, and the Social Cognitive Theory. For each model, the key components, the practical factors to consider and an example of application are presented. The Transtheoretical Model is also briefly discussed.

Box VII. Behaviour change models

Models provide health professionals with information that can explain behaviour and predict changes in behaviour.

- The Health Belief Model proposes that individuals will change their behaviour if they perceive themselves to be at risk, if they perceive the problem to be severe, if they perceive there are benefits in changing the behaviour, if they perceive fewer barriers to carrying out the behaviour and if they perceive that they are capable of carrying out the behaviour.
- The Theory of Planned Behaviour proposes that intention is the strongest predictor of behaviour. Intention is a function of attitudes, normative beliefs and perceived control. Individuals with positive attitudes, positive social support and control over the behaviour will be more likely to intend to change.
- The Social Cognitive Theory proposes that those who perceive they are capable of carrying out the behaviour, who perceive that the behaviour will lead to a desired health outcome and who value the outcome, will be more likely to change their behaviour.

In addition to explaining and predicting behaviours, these models can also provide direction to health professionals when planning the content of interventions (see section 7.2.4).

After the presentation of each model, an example of its use for assessment is provided. The example selected is general in nature and is related to 'improving eating habits/physical activity' or to 'prevent obesity'. The behaviour 'improving eating habits' can be substituted with more specific behaviours such as 'eating fewer high-fat snacks' or 'eating more fruits and vegetables', or 'improving physical activity', etc. The choice of behaviours to change should follow the evaluation of current eating and activity behaviours and identification of problem behaviours of the target population (see section 7.2.1). The health issue under study is obesity, the target population is children/adolescents and the health behaviour is eating/physical activity habits. How the models can help in the design of relevant programmes is further described in chapter 7.

6.2 Health Belief Model

6.2–1 Overview

The Health Belief Model can be applied to children and adolescents or to parents of younger children (under 10 years). Youth are more preoccupied with immediate gratification (feeling good, looking good) than with reducing health risk in the long-term. Nevertheless, more and more adolescents are exposed to the notion of risky health behaviours (drinking, smoking, non-protected sexual activity) and this model may be useful to planners in the domain of obesity prevention, particularly regarding the benefits of, and barriers to, intended behaviour change.

The Health Belief Model stipulates that individuals, to undertake action, must view health as an important dimension of life and must have knowledge about the condition (Janz et al, 2003). Individuals' readiness to take action is a function of their perception of risk and perceived severity of the health issue under study. Individuals must also evaluate the action to be undertaken: this is a function of their perceived benefits of taking action

weighted against the perceived costs of undertaking action. Perceived susceptibility and perceived severity provide the force to act and perceived benefits minus perceived barriers provide the preferred path of action (Becker & Janz, 1985). In the late eighties, Bandura's concept of self-efficacy, one's perceived capacity to perform the behaviour, was added to the model (Rosenstock et al, 1988). Other components include cues to action, such as knowledge and information from health professionals, community members, the media etc. Socio- demographic characteristics such as family economic status will also influence individuals' perceived risk, severity, benefits, and barriers.

Janz et al (2003) reported that the perceived barriers component of the model has been found to be the most important predictor of health behaviours. Perceived susceptibility was also an important predictor, particularly for preventive health behaviours. A limitation of the model is that it does not consider that health behaviours are also influenced by motives other than health and beyond individual control (i.e., policy, legislative, community, or institutional factors). Therefore, the model should be used not in isolation but with other theoretical perspectives.

6.2–2 Issues to consider in the application of the Health Belief Model

The model has been applied for various purposes, for instance: to predict dieting and exercising behaviours of obese and non- obese adolescents (O'Connell et al, 1985); to predict dietary fat intake (Schafer et al, 1995); and to predict glycemic control in type 2 diabetes (Daniel & Messer, 2002). Even more relevant to obesity prevention, the model has been integrated into numerous theoretical perspectives for behaviour change for preventing type 2 diabetes in minority youth in the USA (Burnet et al, 2002), for planning a community-wide media campaign to promote walking (Wray et al, 2005) and for modifying eating behaviours to control weight and improve health (Wierenga & Oldham, 2002).

In many studies which have applied the Health Belief Model, the components of the model (perceived risk, perceived severity, perceived benefits, perceived barriers, perceived capacity to change) have been tested using various questionnaires as the authors of the model have not provided explicit instructions on how to assess each component of the model. When developing a new questionnaire, one should consult colleagues who are familiar with:

1. the theoretical underpinnings of the model,
2. the behaviours under study,
3. the methodology of questionnaire development.

If using measures from previous studies, one should ensure that their validity and reliability are adequate. If constructing components of the model, Janz et al (2003) recommend that:

1. the components developed are consistent with the theory,
2. the component measurement is specific to the behaviour (i.e., barriers for adolescents attempting to improve eating habits to prevent obesity will be different from barriers to increase consumption of vitamin A-rich vegetables to prevent blindness),
3. there are multiple items in each component to reduce measurement error, thereby increasing validity.

A partial example of an application of the components of the Health Belief Model is presented in Table 1. Additional questions on physical activity may be developed. For young school-children, similar questions could be addressed to parents.

Table 1. Application of the Health Belief Model

PERCEIVED SEVERITY	Not serious				Extremely serious
- How serious would it be for your health if you were obese ?	1	2	3	4	5

PERCEIVED RISK	Not at risk				Extremely at risk
- Do you think that your health would be at risk if you were obese?	1	2	3	4	5
- Do you think that you are at risk for developing diabetes in the future if you are obese?	1	2	3	4	5

PERCEIVED BENEFITS	Not helpful				Extremely helpful
- Do you think that improving your eating habits would help you prevent obesity?	1	2	3	4	5
- Do you think that improving your eating habits would help you improve your health?	1	2	3	4	5
- Do you think that improving your eating habits would make you feel better?	1	2	3	4	5
- Do you think that improving your eating habits would make you look good?	1	2	3	4	5

PERCEIVED BARRIERS	Extremely difficult				Not difficult
- Do you think that improving your eating habits is difficult because many foods taste good?	1	2	3	4	5
- Do you think that improving your eating habits is difficult because many healthy foods are not readily available?	1	2	3	4	5
- Do you think that improving your eating habits is difficult because many healthy foods are expensive?	1	2	3	4	5
- Do you think that improving your eating habits is difficult because your family does not eat well?	1	2	3	4	5
- Do you think that improving your eating habits is difficult because your friends do not eat well?	1	2	3	4	5

Note: A similar questionnaire can be developed for physical activity.

The mean score of each component is calculated after ensuring that there is overall consistency for the assessment between the wording and the scoring. Internal consistency reliability (Cronbach alpha coefficient) should be determined for each component; the more items in the component, the greater likelihood of obtaining higher reliability coefficients. Low reliability may reduce the chances of getting significant associations when in fact they do exist.

6.3 Theory of Planned Behaviour

6.3–1 Overview

The Theory of Planned Behaviour is an important theoretical perspective to consider in predicting children/adolescents' eating habits because it includes an assessment of social influences (i.e., family members, friends, peers, etc.) on the behaviour.

The key components of the Theory of Planned Behaviour include:

1. intention,
2. attitude towards a behaviour (behavioural beliefs, outcome evaluation),
3. subjective norms (normative beliefs, motivation to comply),
4. perceived behavioural control (control beliefs, perceived power).

The Theory of Planned Behaviour (Ajzen, 1991) is an extension of the Theory of Reasoned Action (Ajzen & Fishbein, 1980). The main assumptions of the theory are (Ajzen, 1991): 1) individuals usually behave rationally; 2) they take into account the information that is available and use it; and 3) they consider the implications of their actions before undertaking a behaviour. The behaviour under study should be well defined.

Intention is viewed as the most immediate determinant of an individual's behaviour. A person's intention is a function of three determinants: attitude toward a behaviour (personal influence), subjective norms (social influence), and perceived behavioural control (environmental influence).

Attitude is the person's positive or negative evaluation of performing the behaviour (Ajzen, 1985), i.e., good/bad, beneficial/harmful. Attitudes can be estimated or determined from behavioural beliefs and outcome evaluation (Ajzen & Fishbein, 1980). Behavioural beliefs are a person's salient beliefs that the behaviour is linked to an outcome. Outcome evaluation is the value of the outcome for the person.

For example, the person must believe that improving eating habits will decrease the chances of having excess weight (behavioural beliefs); and the person must also value the outcome - decreasing the chances of having excess weight is perceived as good (outcome evaluation). For this reason, each salient belief is multiplied by the outcome evaluation of that belief and the sum of all beliefs should predict the attitudes of the individual toward the behaviour.

Subjective norm is the person's perception of the social pressure to perform or not perform the behaviour (Ajzen, 1985). Subjective norms can be estimated or determined by normative beliefs and the motivation to comply (Ajzen & Fishbein, 1980). Normative beliefs are the person's beliefs whether or not specific individuals or groups think he/she should perform or not perform the behaviour. Specific individuals or groups can include: family members, friends, teachers, doctors, school nurses, cultural community, etc. Motivation to comply is the person's willingness to comply with the specific individual's or group's views.

For example, the person must believe that the mother, the father, the brother, the sister, friends, the teacher, the doctor, the school nurse... want him/her to improve eating behaviours; and, the person must also want to comply with the mother's, the father's, the brother's, the sister's, the friend's, the teacher's, the doctor's, the school nurse's views. To predict subjective norms, normative beliefs are multiplied by motivation to comply.

Perceived behavioural control is the person's perceptions of the resources and opportunities available to perform the behaviour (Ajzen, 1991). Perceived behavioural control can be estimated or determined by control beliefs and perceived power (Montaňo & Kasprzyk, 2003; Ajzen, 1991). Control beliefs are the perceptions of the person as to whether or not he/she has the resources (presence or absence of facilitators and barriers) to be able to carry out the behaviour. Perceived power refers to the perceptions of the person as to whether or not the factors/conditions identified in control beliefs make it difficult to perform the behaviour.

For example, the person must identify the facilitators and barriers of carrying out the behaviour as well as the contribution of each factor in making it difficult to perform the behaviour. Control beliefs are multiplied by perceived power to predict perceived behavioural control.

Montaňo & Kasprzyk (2003) note that for some behaviours, attitudinal considerations may be more important than either normative considerations or control considerations, or vice- versa. The relative importance of each of the three determinants may vary with the behaviour under study. To adopt a behaviour, a person must view the behaviour as positive and beneficial, and must feel that the environment is supportive and that the required resources are available (Park & Ureda, 1999). For instance, if obesity in women is perceived as positive in a given culture, girls may be reluctant to engage in a programme to prevent obesity.

6.3–2 Issues to consider in the application of the Theory of Planned Behaviour

The Theory of Reasoned Action and the Theory of Planned Behaviour have been applied to determine, among others: soft drink consumption (Kassem et al, 2003); sugar restriction (Masalu & Astrom, 2003); dairy product intake (Kim et al, 2003); dietary supplement use (Conner et al, 2003, 2001); fruit and vegetable consumption (Lien et al, 2002); attitudes towards food containing fats among subjects with different body weights (Saba et al, 1999); and weight loss (Schiftier & Ajzen, 1985). It has also been used to explain adolescents' smoking and drinking behaviour (Spijkerman R et al, 2004), and to predict healthy eating among adolescents (Gronhoj et al, 2012).

Ajzen & Fishbein (1980) provide instructions on how to develop the questions and response scales for each component of the theory. They recommend that attitudes, salient beliefs, and significant others be identified by the target audience themselves. They propose a specific methodology for questionnaire development that includes a pilot study to determine salient beliefs. An application of the Theory of Planned Behaviour is outlined in Table 2.

Table 2. Application of the Theory of Planned Behaviour

INTENTION	Unlikely						Likely
I intend to improve my eating habits within the next 6 months to decrease my chances of becoming obese.	1	2	3	4	5	6	7

ATTITUDE Improving my eating habits is:	Bad						Good
	1	2	3	4	5	6	7

Improving my eating habits is:	Harmful						Beneficial
	1	2	3	4	5	6	7

Improving my eating habits is:	Unpleasant						Pleasant
	1	2	3	4	5	6	7

BEHAVIOURAL BELIEFS Improving my eating habits will:	Unlikely						Likely
- be useful in decreasing my chances of becoming obese. .	1	2	3	4	5	6	7
- be useful in improving my health.	1	2	3	4	5	6	7
- be useful in helping me feel good.	1	2	3	4	5	6	7
- be useful in helping me to look good.	1	2	3	4	5	6	7

OUTCOME EVALUATIONS	Bad						Good
- Decreasing my chances of becoming obese is:	1	2	3	4	5	6	7
- Improving my health is:	1	2	3	4	5	6	7
- Feeling good is:	1	2	3	4	5	6	7
- Looking good is:	1	2	3	4	5	6	7

SUBJECTIVE NORMS Most people who are important to me think that I:	Should Not						Should
Improve my eating habits	1	2	3	4	5	6	7

NORMATIVE BELIEFS Improve my eating habits	Should Not						Should
My mother thinks that I:	1	2	3	4	5	6	7
My father thinks that I:	1	2	3	4	5	6	7
My friends think that I:	1	2	3	4	5	6	7
My doctor thinks that I:	1	2	3	4	5	6	7
My school teacher thinks that I:	1	2	3	4	5	6	7

MOTIVATION TO COMPLY

How much do you want to do what:	Not at all						Very Much
- your mother thinks you should do.	1	2	3	4	5	6	7
- your father thinks you should do.	1	2	3	4	5	6	7
- your friends think you should do.	1	2	3	4	5	6	7
- your doctors think you should do.	1	2	3	4	5	6	7
- your school teacher thinks you should do.	1	2	3	4	5	6	7

PERCEIVED BEHAVIOURAL CONTROL

How much control do you feel you have	No Control						Great Control
Over improving your eating habits?	1	2	3	4	5	6	7

CONTROL BELIEFS

How difficult is it for you to improve your eating habits, if foods you would have to eat:	Very Difficult						Very Easy
- do not taste good.	1	2	3	4	5	6	7
- are not readily available.	1	2	3	4	5	6	7
- are expensive.	1	2	3	4	5	6	7
- are not liked by your family.	1	2	3	4	5	6	7
- are not liked by your friends.	1	2	3	4	5	6	7

PERCEIVED POWER

To what degree do the following conditions prevent you from improving your eating habits:	Great Influence						No Influence
- foods I would have to eat do not taste good.	1	2	3	4	5	6	7
- foods I would have to eat are not readily available.	1	2	3	4	5	6	7
- foods I would have to eat are expensive.	1	2	3	4	5	6	7
- foods I would have to eat are not liked by my family.	1	2	3	4	5	6	7
- foods I would have to eat are not liked by my friends.	1	2	3	4	5	6	7

Note: A similar questionnaire can be developed for physical activity.

Mean scores for each of the components are calculated. Internal consistency reliability (alpha Cronbach coefficients) is also calculated (see section 6.2).

6.4 Social Cognitive Theory

6.4–1 Overview

The Social Cognitive Theory is a theoretical perspective frequently used in predicting behaviours. It was introduced in 1977 by Bandura as 'Social Learning Theory', and renamed in 1986 as 'Social Cognitive Theory'. The main components of Social Cognitive Theory which predict behaviour include:

1. efficacy expectations: self-efficacy, that is, the conviction that one can successfully execute the behaviour
2. outcome expectations: the person's perception that the behaviour will lead to certain outcomes; and
3. outcome expectancies: the value the person attributes to the outcome (Bandura, 1995, 1986, 1977).

For example, the person must have confidence in being able to improve eating habits (self-efficacy), the person must perceive that improving eating habits will decrease chances of having excess weight (outcome expectations), and that decreasing chances of having excess weight is important (outcome expectancies).

The Social Cognitive Theory's concept of outcome expectations is similar to the Theory of Planned Behaviour's concept of behavioural beliefs, and the Social Cognitive Theory's concept of outcome expectancies is similar to the Theory of Planned Behaviour's concept of outcome evaluation.

Bandura views behaviour as dynamic and influenced by the simultaneous interaction between the characteristics and the behaviour of the person, and the environment in which the behaviour is performed (Baranowski et al, 2003). This interaction between the person, the behaviour, and the environment is referred to as reciprocal determinism. The relative influence of each of these three factors will vary for different behaviours, different circumstances, and different individuals (Bandura, 1986).

Self-efficacy, an individual's confidence in being able to carry out a behaviour, is based on four factors (Baranowski et al, 2003; Bandura, 1995, 1977):

1. previous performance accomplishments, including successes and failures. Strong self-efficacy is developed by repeated successes. Providing individuals with the opportunity to accomplish small steps (or sub-components of the behaviour) that leads to the overall accomplishment of the behaviour is important to consider for increasing self-efficacy perceptions,
2. vicarious experience, that is, seeing others perform a behaviour without negative consequences. This can lead individuals to expect that they themselves will be able to carry out the behaviour with the same results. Modeling and observational learning are important,
3. verbal persuasion, that is, individuals are persuaded by the comments of others that they are able to do the behaviour. Positive social support can increase perceptions of self-efficacy,
4. emotional arousal, that is, specific arousal resulting from stressful situations. An examination of which types of situations cause emotional arousal is useful so that, subsequently, steps can be taken to reduce the threatening situation, enabling individuals to perform the behaviour.

Bandura's original concept of self-efficacy has undergone intensive study and development (Rossi et al, 2001). The notion of situational self-efficacy, that is, perceived ability to carry out a behaviour in different situations, is also predictive of behaviour (Ôunpuu et al, 2001).

Other notions in Social Cognitive Theory which may be useful in better understanding an individual's behaviour include the environment, behavioural capacity, observational learning, and goal-setting. The environment in which the individual functions provides motives, for or against, undertaking a behaviour. It is useful to consider the physical as well as the social environment. The physical environment can include the availability of food products at home, school, fast-food restaurant or foods sold on the street. The social environment can include family members and friends, peers at school, or community group members. Baranowski et al (2003) note that how individuals view their environment affects whether or not they adopt a given behaviour.

The notion of behavioural capacity implies that the individual must know what to do and have the skills to carry out the behaviour. In other words, the individual must be knowledgeable about the behaviour and must have the skills necessary to do so. This is an interesting concept in that it brings up the issue of knowledge designed to improve the skills of individuals so that they may accomplish the behaviour (skills to make healthier food choices, etc). Motivational-oriented knowledge (reasons for conducting the behaviour) and skill-oriented knowledge (how to conduct the behaviour) are distinct and both should be considered (Contento, 1995).

Observational learning is important particularly among children/adolescents when they observe their parents or their peers perform positive health behaviours. Reinforcements are also useful. They can include self-reinforcement, direct reinforcement and vicarious reinforcement as in observing others (Baranowski et al, 2003). Goal-setting and monitoring one's behaviour may sustain self-control.

6.4—2 Issues to consider in the application of the Social Cognitive Theory

The concept of self-efficacy has been applied to understand dietary fat intake (Liou & Contento, 2001; Ôunpuu et al, 2001; Rossi et al, 2001; Sallis et al, 1988); disordered eating among adolescents (Neumark-Sztainer et al, 1996); physical exercise and obesity among adolescents (Hawley et al, 2009; Winters et al, 2003); fruit and vegetable intake (Molaison et al, 2005; Ma et al, 2002); calcium intake among adolescents (Ievers-Landis et al, 2003; Lee & Reicks, 2003), diabetes management (Vallis et al, 2005; Anderson et al, 2000), and healthy eating (Monge-Rojas et al, 2005).

An application of selected components of Social Cognitive Theory is outlined in Table 3. The application draws upon the work of Ôpunu et al (2001), Rossi et al (2000), and Sallis et al (1988).

Table 3. Application of Social Cognitive Theor

SELF-EFFICACY Overall, how confident are you of being able to:	Not At All Confident						Extremely Confident
Improve your eating habits.	1	2	3	4	5	6	7
Eat smaller portion sizes	1	2	3	4	5	6	7
Reduce your dietary fat intake.	1	2	3	4	5	6	7
Reduce the number of times per week that you eat at a fast-food restaurant.	1	2	3	4	5	6	7
Reduce the number of times per week that you eat fried-foods sold in the street.	1	2	3	4	5	6	7

SITUATIONAL SELF- EFFICACY How confident are you in being able to improve your eating habits in the following situations:	Not At All Confident						Extremely Confident
When eating at home.	1	2	3	4	5	6	7
When eating with friends.	1	2	3	4	5	6	7
When eating at a fast-food restaurant.	1	2	3	4	5	6	7
When eating food bought in the street.	1	2	3	4	5	6	7
When eating alone.	1	2	3	4	5	6	7
When preparing your own meal.	1	2	3	4	5	6	7
When others around you are not eating well.	1	2	3	4	5	6	7

OUTCOME EXPECTATIONS Do you think that improving your eating habits	Not At All						Very Much So
Will decrease your chances of obesity?	1	2	3	4	5	6	7
Do you think that improving your eating habits will help improve your health?	1	2	3	4	5	6	7
Do you think that improving your eating habits will help you feel good?	1	2	3	4	5	6	7
Do you think that improving your eating habits will help you look good?	1	2	3	4	5	6	7

OUTCOME EXPECTANCIES Decreasing my chances of having	Not At All Important						Extremely Important
Excess weight is:	1	2	3	4	5	6	7
Improving my health is:	1	2	3	4	5	6	7

Note: A similar questionnaire can be developed for physical activity.

6.5 Transtheoretical model

6.5–1 Overview

The Transtheoretical Model, or Stages of Change (Glanz et al, 2003), is useful in understanding how behaviour change occurs. It is also useful in guiding content development of interventions.

In the Transtheoretical Model, change is viewed as a dynamic phenomenon and is multi- dimensional in nature (Prochaska & DiClementi, 1986). It consists of a framework that covers the full course of change, from being aware of a problem to the time when the problem no longer exists. The model was developed from over 30 theories of psychotherapy (Prochaska & Velicer, 1997).

The key components of the Transtheoretical Model are the six stages of changes (Prochaska & Velicer, 1997):

1. Precontemplation Stage, in which individuals are not intending to take action in the foreseeable future,
2. Contemplation Stage, in which individuals are intending to take action in the next six months,
3. Preparation Stage, in which individuals are intending to take immediate action in the next month,
4. Action Stage, in which individuals have taken action within the past six months,
5. Maintenance Stage, in which individuals are preventing relapse,
6. Termination Stage, in which individuals are maintaining action and there is no temptation to return to previous behaviours, not even if depressed, anxious, bored, lonely, angry, or stressed.

Other components of the model include: decisional balance, self-efficacy, and temptations (Prochaska et al, 2003; Prochaska & Vericer, 1997). Decisional balance is the individual's weighing of the pros and cons of changing. Self-efficacy is referred to the situation-specific confidence that an individual has that will prevent him/her from relapsing to the problem behaviour. Temptation refers to the intense urges resulting from emotional distress, social situations, or cravings. The model also presents 10 processes of change, including consciousness raising, from Freud's perspective, contingency management, from Skinner's perspective, and helping relationships, from Roger's perspective (Prochaska & Velicer, 1997). These processes are complex to apply and have not received much attention in nutrition initiatives.

Individuals may not progress from one stage to another in a linear fashion and they may relapse to an earlier stage (Prochaska et al, 1992). The best predictor of relapse is low levels of self-efficacy (Prochaska & DiClemente, 1982).

6.5–2 Issues to consider in the application of the Transtheoretical Model

The Transtheoretical Model has been applied: to investigate the distribution across the different Stages of Change in 15 European communities for general eating habits (de Graaf et al, 1997); to assess the effect of dietary interventions on fat consumption (Frenn et al, 2003: Finckenor & Byrd-Bredbenner, 2000; Greene & Rossi, 1998); to assess the association between Stages of Change and fruit and vegetable intake (Di Noia et al, 2006; Resnicow et al, 2003; Campbell et al, 1999b); for diabetes management (Jones et al, 2003; Kasila et al, 2003; Sutton et al, 2003; Vallis et al, 2003); for weight loss (Chae et al, 2010; Riebe et al, 2003; Logue et al, 2000) and for physical activity among young adults (Dishman et al, 2010; Maddison & Prapavessis, 2006; Woods et al, 2002; Nigg, 2001).

One of the major concerns in applying the model is the methodology used to classify individuals according to the Stages of Change. Kristal et al (1999) discussed advantages/ disadvantages of various methods. Stage of change can be determined by the individual, the health professional, or an algorithm using both the individual and health professional assessments. The advantage of using the individual's assessment is that it is based on the evaluation of his/her behaviour which can be an underlying force for behaviour change. For this reason, however, this model may be more appropriate for older children.

An application of the model to characterize an individual's stage of change is outlined in Table 4. It is based on the work of Green & Rossi (1998).

Table 4. Application of the Transtheoretical Model

Are you improving your eating habits to lower your chances of obesity?

☐	Yes, I have been doing so for more than 6 months	MAINTENANCE
☐	Yes, I have but for less than 6 months	ACTION
☐	No, but I intend to in the next 30 days	PREPARATION
☐	No, but I intend to in the next 6 months	CONTEMPLATION
☐	No, and I do not intend to in the next 6 months	PRECONTEMPLATION

Note: A similar questionnaire can be developed for physical activity.

In conclusion, the frameworks for behaviour assessment and change presented in this section focus primarily on personal factors and the individual's immediate social environment. They must be combined with the ecological approach when planning initiatives to change behaviours, as seen in the next chapter.

7. PLANNING OBESITY PREVENTION PROGRAMMES

The principles of planning interventions are universal and can be applied in both developed and developing countries. It is their application that will shape the programme developed. Lessons learned from obesity prevention programmes in developed countries will be referred to in this text, with the view of stimulating reflection and dialogue among health and nutrition professionals planning obesity prevention programmes in developing countries.

7.1 Planning programmes for school-children/adolescents

Planning programmes for school children and adolescents requires special considerations. School children are more dependent on parental influences than adolescents, and parents must be an integral part of any initiative. Adolescence is a stage of uncertainty and implies changes in physical characteristics and social roles. It is a time of preoccupation with body image and appearance; acceptance by peers; influence of peers, significant cultural figures and commercial sales; rejection of parental authority; and, struggle for independence (Kennedy Elder, 2004; Spear, 2000). Adolescents have generally been given little health and nutrition attention compared to younger children and adults (Delisle 2008); however, many of them can be reached through school-based programmes in developing countries, particularly in urban areas. With dietary and lifestyle changes typical of nutrition transition, increases in rates of obesity have been reported among adolescents in several developing countries. The challenge in inducing healthier lifestyle behaviours is great because adolescents focus on immediate gratification, whereas the benefits of changing lifestyle behaviours are related to reduction in risk for chronic diseases in later life. This reinforces the importance that messages should primarily focus on changing lifestyle behaviours to look good and feel fit today.

The ultimate purpose of obesity prevention programmes is to foster positive lifestyle behaviours by empowering and motivating children and adolescents to improve their dietary patterns and physical activity practices, and by facilitating this through action on the environment. In order to do so, current eating and physical activity patterns have to be documented, but more importantly, the environmental and social drivers of change need to be ascertained, using a solution-, rather than a problem-oriented approach (Robinson & Sirard, 2005). In addition to eating and physical activity patterns (work and leisure activities), children/adolescents' perceptions of their own weight and that of their peers also need to be assessed. Perception of weight should concord with actual weight since it is associated with dieting behaviours. Normal weight adolescents who perceived themselves to be overweight were reported to be at risk for undertaking potentially dangerous dieting behaviours (Currie et al, 2004). Development of a positive body image and self-esteem are useful preventive strategies.

7.2 The planning process

There are numerous programme planning models which provide a framework for planning health promotion and prevention initiatives. One of the best known and applied is Green's PRECEDE-PROCEED Model. The model integrates the ecological approach and addresses the role of genetic, environmental and behavioural determinants of health (Green & Kreuter, 2005).

In this section, only key components of the planning process are presented. It is a simplified guide to assist health and nutrition professionals plan obesity prevention initiatives. It consists of five steps: community and individual assessment; identification of the targets for change (community, family, individual level); setting objectives; determining programme methods; and planning the evaluation.

7.2–1 Community and individual assessment

Prevention of obesity is as complex as its aetiology and should include a multi-level (national, community, individual), multi-disciplinary (physicians, nutritionists and other health care workers, teachers, community members, family members), and multi-organizational (world, national, governmental, institutional, civil society) approach.

The planning process begins by establishing a planning team (approximately 6-9 individuals) that includes health professionals, community leaders, and representatives of the target population. The role of the planning team is to develop, implement, and evaluate the programme once funding has been allocated; their role is not to advocate for funds (Solomon, 2005).

Assessment of the current situation

The process usually begins with an assessment of the current situation, including the problematic behaviours that contribute to higher rates of obesity, and the available social and environmental resources for change. The assessment is a necessary step, but it should not divert undue time and efforts away from action. Even at this stage, the focus should be on solutions, not on the problem (Robinson & Sirard, 2005). The planning team should determine, for their specific region, the parameters listed in the next box, at the light of existing data inasmuch as possible. Sections of this document where the issues are discussed are given in parentheses.

Box VIII. A diagnosis of the current situation

- Overweight and obesity rates among children/adolescents and characteristics that are associated with higher rates: region, sex, age, economic status, living conditions, etc.; [see sections 3.2, 5.1]
- Frequency of dietary patterns associated with higher obesity rates: skipping meals, high-fat or high-sugar snack foods, high-fat fast-foods (either purchased in the street or in a fast-food outlet), sugar-sweetened beverages, dieting behaviours, inadequate intake of fruits, vegetables, dairy products, etc.; [see section 4.3]
- Nutrient intakes to assess vulnerability, if feasible; [see section 5.2]
- Physical activity patterns and characteristics of children/adolescents who are not active; [see section 5.3]
- Community and school resources available for recreational/physical activities;
- Community and school food supply: food products, school lunch programme; sale venues (market, streets, grocery stores, etc.);
- School, community, and health programmes already addressing the problem of obesity or general health among school children/adolescents;
- Social perceptions of obesity as viewed by youth and adults in the community, and by health and nutrition workers in the community;
- Public, societal, and commercial pressures which may positively or negatively affect lifestyles, such as a culturally negative perception of women's involvement in sports activities.

While often neglected by planners, information should include children/adolescents' perceptions towards obesity in their specific region as well as perceptions towards the health behaviours to be adopted. These perceptions are mediated by cultural, societal and commercial values as well as peer/family pressures. This information is crucial to recognise the barriers and facilitating factors for implementing the intervention and the types of infrastructures that require change. Overall, this assessment is needed to determine the extent of the problem, problematic behaviours requiring change and social characteristics associated with the problem. Thereafter, the targets for change and the objectives can be identified. This assessment will also provide baseline data to measure change after the intervention and, as such, programme success.

A series of questions, designed to raise a broad spectrum of issues, are presented in Table 5 to assist planners identify the current situation. Not all questions need to be asked. Some questions may not be applicable in certain regions and planning teams are encouraged to add location-specific questions. Depending on resources

available to the planning team, these questions may be part of national/local health surveys, or they may be part of group sessions held with members of the planning team (health professionals, community members, children/adolescents). Information can come from various sources: surveys, focus groups, interviews with selected community leaders and children/adolescents themselves.

Table 5. Questions to guide the baseline assessment of obesity and its determinants

What is the prevalence of obesity among school children and adolescents in relation to the demographic and social characteristics?	What percentage of the population in a given region is underweight, normal weight, overweight, and obese? What is the proportion of overweight and obese children/adolescents according to age, sex, ethnicity and economic status? What is the composition, income and health status of the overweight/obese child/ adolescent households? What are the community and religious affiliations of children/adolescents and their household members?
What are the nutrient intakes and dietary patterns of children/ adolescents?	Are children/adolescents meeting their nutrient requirements? What are the nutrient deficiencies and excesses? What is the frequency, type, and amount of consumption of: fruits and vegetables? protein-containing products? dairy products? Grains and tubers (are they high in fibre and do they have a low-glycemic index)? What is the frequency, type, and amount of fat used in cooking, in food preparation, and added at the table? What is the frequency, type, and amount of high-fat foods, high-fat/ high sugar/ high sodium snack foods, and high-fat fast-food meals consumed? What is the frequency, type, and amount of sugar-sweetened foods and drinks consumed? What is the frequency of transformed food product?
What are the meals/ snacks patterns?	Which meals do children/adolescents eat at home? Which family members are present at mealtime? What activities are undertaken at mealtime? How frequently are meals consumed outside the home? In what types of establishments? What types of foods are consumed by children/adolescents in these establishments? Are children/adolescents undertaking unsafe dieting practices? What is the extent of the problem and what practices are used?

What are children's/ adolescents' perceptions towards obesity and what are the cultural and community influences?	What do children/adolescents think about obesity? What are the cultural and community influences on children/adolescents' views of obesity? Are children/adolescents aware of the health risks of obesity? What do they know about the consequences of diabetes and cardiovascular disease? Are they able to assess their own health risks? What are the perceptions towards an individual who is underweight, normal weight, overweight, and obese? Do children/adolescents like their current weight? What do children/adolescents perceive as the benefits of improving dietary and activity patterns, and what are the barriers? What are the influences of the family on children/adolescents' food consumption? Who are the significant individuals (media/village personalities, friends, family members, physicians, teachers, etc) who influence children/adolescents' food consumption (positively or negatively)? What are the religious and cultural influences on children/adolescents' food consumption? What is the media's influence on children/adolescents' food consumption?
What is childrens' / adolescents' skill-related knowledge for improving dietary patterns?	Do children/adolescents know which foods in their diets contribute to a high energy intake? What do they think about 'low-calorie' and 'healthy foods' (where appropriate)? Do children/adolescents understand the importance of portion size? What are the barriers (financial, taste, peer influence, cultural influence, food availability, etc.) from selecting healthy foods at home, in the store (label reading), at school (availability), at fast-food restaurants, etc.? Do adolescents have the skills to prepare healthy meals and snacks?
What are the physical activity patterns of children/adolescents?	What is the frequency and intensity of day-to-day activities of children/adolescents (walking to school, doing chores at home, helping family members, etc.)? What is the frequency of recreational activities undertaken by children/adolescents during school hours/outside the school? What types of activities are undertaken?
What family support is available to children/adolescents?	What types of food are available at home? How does the family encourage positive dietary patterns and increased physical activity?

What are the school resources available to children/ adolescents?	How does the school system encourage positive dietary patterns and increased physical activity? Does the curriculum contain obesity and health-related content? Is it compulsory? What foods are available at the school for breakfast, lunch, snacks, sports and social events? Are low-cost healthy food products available? Are there fast-food or street-food outlets located near the school? Do children/ adolescents frequent these sites? How many students? How frequently? Is there a nurse at the school? Does he/she conduct health risk assessments? Does he/she organize health promotion activities?
What are the local and community resources available to children/ adolescents?	What types of food-outlets are available? Are low-cost healthy food products available? What is the number of fast-food type restaurants in the area? Where are they located? What are the recreational facilities available? What are the factors that facilitate their use and what are the barriers that hinder their use? Where are these facilities located? Who can have access to these facilities? What medical services and health programmes are available in the community for children/adolescents? Do any address the problem of obesity, general health, nutrition and physical activity? Are these services free? Who has access to these services? Is there a long waiting list? Do community groups and organizations offer food or financial aid to selected groups? Do they target children/adolescents?

These questions are useful to examine the issues that should be considered when planning the programme. Afterwards, planners will be able to identify the most significant problems requiring change and identify how change may be achieved. The scope of the planned programme will depend on available resources, infrastructures and feasibility of changing certain behaviours and the desire of the youth community to change.

Using the PRECEED approach and based on this initial assessment, predisposing (personal), facilitating (environmental) and reinforcing (significant others) factors of current problem behaviours can be identified. These can be either positive or negative. For instance, the lack of outdoor space for sports in schools is a negative environmental factor, whereas the perceived importance of physical fitness would be a positive predisposing factor for physical activity. A similar analysis may then be performed for targeted behaviour changes, with efforts to strengthen positive factors and to alleviate the negative ones, as further discussed in Section 7.2.4.

7.2–2 Identification of targets for change (community, family, individual level)

An ecological perspective is useful in identifying the targets for change in children/adolescent obesity prevention programmes (Institute of Medicine, 2005; Wethington, 2005). Changes can occur at various levels: the community, the family and the individual. Examples of actions that could be taken at the community, family, and individual levels are outlined below (Kumanyika et al, 2002). Policy issues and changes at the national level are addressed later in this document (Chapter 8).

Box IX. Examples of targets for change

Community level:

- ☐ Including an obesity prevention component as part of the school programme, increasing availability of healthy food choices at informal youth gatherings, initiating groups sessions at local youth centres
- ☐ Providing obesity prevention and treatment services at local health clinics and facilities
- ☐ Modifying children's/ adolescents' social perceptions of obesity and health and lifestyle behaviours through community campaigns
- ☐ Increasing availability of healthy food choices at food outlets: in street venues, markets, grocery stores, near schools, etc.
- ☐ Increasing facilities for recreational activities: increasing safe walking zones, recreational venues, etc.

Family level:

- ☐ Ensuring availability of healthy and diversified food products in the household.
- ☐ Fostering family support for children/adolescents to adopt healthy lifestyle behaviours

Individual (children/adolescents) level:

- ☐ Reducing barriers to improve dietary patterns and activity patterns
- ☐ Increasing knowledge about the gravity of the problem and how it may impact on immediate and future health, resulting in greater awareness for the benefits of changing lifestyle behaviours
- ☐ Increasing capacities to undertake positive behaviours through skill development, problem solving, coping with social and peer pressures, etc.

The level of change targeted by the obesity prevention programme will depend on the planning context and amount of resources available. It will also be influenced by the individual members of the planning committee, the results of the assessment of the current situation, and the group decisions made by the planning committee. The outcome sets the groundwork for the establishing the intervention's objectives, methods, and evaluation. Each programme planned will be unique and will be different in different countries and regions.

7.2–3 Setting Objectives

The planners will have to decide what they want to achieve (objectives or expected results, i.e., to reduce the rate of obesity; to prevent increases in the rates of obesity) and how it will be achieved in their specific region (targets for change). What changes will have the most impact on reaching the programme objectives? It should be remembered that information alone does not foster behavioural change, although many programmes continue to focus on providing information, and on measuring knowledge change for the evaluation. What are the best ways to reach children/adolescents in the community (i.e., via the family, the school, the street, community centres, or recreational settings)? What lifestyle behaviours are to be targeted (i.e., skipping meals, consumption of snack foods, low consumption of fruits and vegetables, etc)? These are arbitrary decisions of the planning team based on the best available information and results of the assessment.

Box X. Examples of programme objectives or intermediate targets

1. to increase children/adolescents' awareness of the obesity epidemic
2. to increase children/adolescents' understanding of the health consequences of obesity
3. to improve children/adolescents' conception of healthy weights
4. to improve children/adolescents' understanding of the role of media in influencing body image
5. to increase the number of schools in the region that offer healthy food choices
6. to increase the number of recreation facilities accessible to children/adolescents
7. to increase children/adolescents' intake of fruits and vegetables
8. to decrease children/adolescents' consumption of high-fat snack foods and fast-foods
9. to decrease children/adolescents' consumption of sugar-sweetened beverages
10. to reduce children/adolescents' frequency of skipping breakfast
11. to improve children/adolescents' views of healthy portion size
12. to improve children/adolescents' skills in preparing healthy meals

7.2–4 Determining programme methods

A decision is needed to determine the best fit between the programme methods and the objectives. For example, if the objective consists of increasing awareness of the obesity epidemic and its health consequences, then, a media campaign (i.e., radio announcements, flyers sent to households, village meetings) may be the preferred method. If the objective consists of modifying services in local community facilities, then, advocacy activities such as town meetings, conferences, and promotional materials designed to convince decision makers may be considered. If the objective consists of increasing consumption of fruit and vegetable, then, a school publicity campaign, booths at sites frequented by school-children (i.e., recreational areas), and group/individual sessions with children/adolescents/families may be warranted. Community-wide campaigns, school-based interventions, and mass-media strategies are but a few examples. Children/adolescents can be reached through families, schools, recreational centres, mass-media, and health services (Kennedy Elder, 2004).

Theoretical perspectives for behaviour change (Chapter 6) can be useful in guiding the development of programme content and activities.

The Transtheoretical or Stages of Change model can identify children/adolescents' readiness to change and should be considered (Prochaska et al, 2003; Greene et al, 1999; Kristal et al, 1999).

- If children/adolescents are contemplating change, then attention should be given to the reasons for changing behaviours as well as the benefits of undertaking behaviour change (i.e. appearance, feeling good, health, consequences of not undertaking positive behaviours).
- If they are in the action stage of change, then attention should be given to developing skills required for change, and to the perceived barriers to change.
- If they are in the maintenance stage, attention should be given to problem-solving strategies to maintain the behaviours, reinforcement of positive behaviours, and continuous monitoring with adequate follow-up support.

The Health Belief Model can provide direction to changing children/adolescents' perceptions about the health problem and target behaviours:

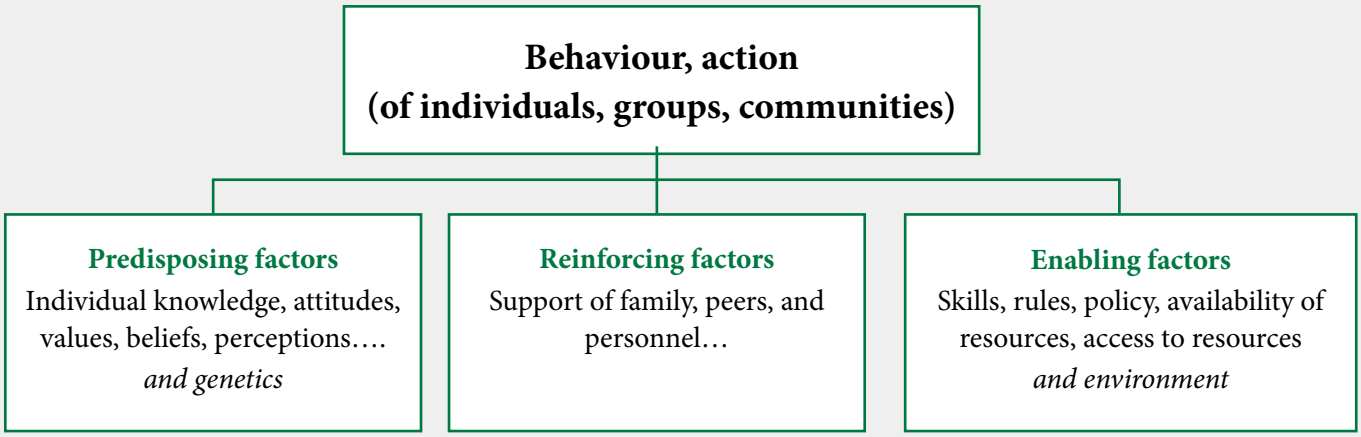
- Perceived severity: discuss the consequences of obesity
- Perceived risk: discuss who is at risk for developing obesity and conduct individual risk assessments
- Perceived benefits: discuss the advantages of taking action
- Perceived barriers: identify the barriers for changing behaviours, brain-storm to identify ways of overcoming the barriers, apply problem-solving strategies to resolve problem behaviours, discuss past success stories in changing behaviours.

The Social Cognitive Theory may also play an important role in programme development. Programmes should be designed to increase children/adolescents' skills to adopt healthy dietary patterns, a key component of Bandura's Social Cognitive Theory (Baranowski et al, 2003). Skills required for healthy eating include food purchasing and food preparation, applicable to older children. Children/adolescents need to feel that they are capable of carrying out the behaviours (concept of self-efficacy). The behavioural change method should be interactive so as to involve the children/adolescents in the process. It should focus on positive behaviours and include role models and testimonials from peers and celebrity figures. It should also include small group discussions in order to address the cultural and societal values related to obesity and healthy eating. A decision must be made to identify the degree of involvement of parents in the programme activities (Kennedy Elder, 2004).

The Theory of Planned Behaviour can be useful in addressing attitudes towards the behaviours as well as peer influence and perceived control over behaviours. The role of media and peer-pressure needs to be discussed with children/adolescents.

The PRECEDE/PROCEED planning model by Green et al (2005) draws upon behaviour change models. It organizes factors which may influence behaviour change into a useful planning framework which can be considered when developing programme content. These factors are outlined in the following box and are linked to the theoretical perspectives discussed in section 6. This planning model may be very useful at the baseline assessment stage, at the planning stage, and for the evaluation. As already mentioned, baseline assessment will allow to identify predisposing, enabling and reinforcing factors of current dietary and lifestyle patterns. The next step would be to select the levels of intervention. Following, objectives related to the intended behaviours of children and adolescents (i.e., increasing consumption of fruits and vegetables, increased physical activity in school) can be formulated, relative to the predisposing, enabling and reinforcing factors.

Box XI. Components of the PRECEDE-PROCEED Model (adapted from Green & Kreuter, 2005) and relationships with behaviour change models



Predisposing factors:	Knowledge Beliefs/values	Health Belief Model/Social Cognitive Theory Health Belief Model/Theory Planned Behaviour
	Attitudes	Theory Planned Behaviour
Enabling factors:	Capacities/skills	Social Cognitive Theory/Stages of Change
	Health/other resources	Social Cognitive Theory/Theory Planned Behaviour
	Regulations/policies	Social Cognitive Theory
Reinforcing factors:	Significant others	Theory Planned Behaviour/Social Cognitive Theory

When planning programme content, special attention should also be given to the development of messages. They should be positively framed. Messages that place emphasis on gain and benefits are effective in adoption of preventive health behaviours (Rothman & Salovey, 1997). Tailoring messages for children/adolescents requires their input to be meaningful (Kennedy Elder, 2004). Obesity prevention programmes among children/adolescents need to focus on positive messages with immediate benefits of improving dietary behaviours and levels of physical activity while at the same time having children/adolescents understand the implications of the obesity epidemic for their future health and that of their communities. In addition, focusing on positive behaviours can minimize the negative reactions towards children/adolescents who are already overweight or obese. There is a delicate balance between fostering positive behaviours and avoiding negative labelling of children/adolescents who are already afflicted with the problem. It is clear that community obesity prevention programmes will include overweight and obese children/adolescents since they will form part of the target population. These individuals should be referred for individual counselling.

Content of the programme should be limited to information directly related to the objectives. There is a tendency to provide too much information, some of which may not be helpful in behaviour change ('need to know' versus 'nice to know'). There is knowledge related to motivation (i.e., health consequences of obesity) and there is knowledge related to skill acquisition (i.e., reading food labels, culinary techniques to prepare healthy meals with available products).

It is a time-consuming task to develop and test materials for the intervention. A common tendency is to develop new material for every new programme.Before deciding on developing new materials, an inventory of already existing material within the public health community is advisable. This may also involve a literature review.

Suggestions for themes to be addressed in the programme are outlined in the following box (Ontario Medical Association, 2005; Lamirande, 1996). Obviously, these may not all be relevant to a given cultural and socio-economic context and must be adapted.

Box XII. Examples of topics for obesity prevention programmes

Dietary Advice	Psychosocial Influence
• Eating balanced meals • Easy ways to have a good breakfast Snack suggestions • Tips to increase fruits and vegetables Tips to increase dairy products • How to cut down on fat Watching portion size • Healthy foods available at home How to prepare healthy meals • How to eat well when away from home	• Benefits of taking action Problems of not taking action • How to overcome barriers to eating well • Positive body image • Dealing with media influence • Views of parents about obesity, weight, healthy diet and exercise • Influence of friends on eating well Whom to go to when in need of medical help for dieting

7.2–5 Planning the evaluation

Evaluation is an important component of the planning process. It provides useful information for the sponsoring agency, it justifies resources to be utilized, and it provides direction for future action. Contrary to common belief, the evaluation is not designed when the intervention is near the end, but at the planning stage. The planning team will have to consider how the evaluation will be done, by whom and when, and to assess the resources required early on in the planning process. The overall purpose of the evaluation is twofold:

1. to determine whether the programme has been implemented as planned;
2. to determine whether the programme objectives have been achieved.

Questions that could be considered by the planning team are outlined in Table 6. They are based on Green et al's (2005) process evaluation, impact evaluation, and outcome evaluation.

Table 6. Questions to guide the evaluation

Process Evaluation	What factors facilitated planning? What were the barriers to planning? Who was instrumental in facilitating the planning process? Were the planning tasks made clear to planners? Was the programme appropriate for the target population? Was the programme content developed according to the planning schedule? Was the programme advertisement done according to the planning schedule? Was the programme advertisement appropriate for the target audience? Were the equipment and materials required for the programme ordered according to the planning schedule? Were the facilities available as planned? Were the materials available on site as planned? Were the sessions taught as proposed? What changes were made to the teaching plans? Did the participants understand the programme messages? Did the participants think that the content was appropriate? Did the participants like the sessions given? Did the participants like the location/facilities of the programme? Did the participants like the length of the programme and the number of sessions offered? Were the costs of the programme within the planned budget? Was the evaluation conducted as planned?
Outcome Evaluation	Were the target behaviours achieved? - knowledge, beliefs, attitudes, capacities - nutrient and dietary patterns - physical activity patterns - resources availability and access, including environmental changes
Impact Evaluation	Were there changes in health status and quality of life? - prevalence of obesity (BMI and body composition indicators) - prevalence of malnutrition/hunger - school performance - long-term trends of the above

The evaluation of complex interventions such as needed to prevent childhood obesity raises a number of issues. First, the reduction of obesity (impact) may take several years to achieve, and may not be considered the primary determinant of the effectiveness of a programme. Shorter-term outcomes, such as healthier eating and lifestyle, are relevant as indicators of success. Secondly, other results such as environmental and policy changes that were achieved through the programme are also important outcomes as they are likely to foster the intended behavioural changes. Finally, some process elements also serve as indicators of success. For instance, access to healthy food and physical activity facilities for increased numbers of school-children/adolescents, empowered youth to make healthier food choices, measures for sustainability and community ownership of the programme are but a few examples of successful health promotion, according to the Ottawa Charter (O'Neill et al, 2006).

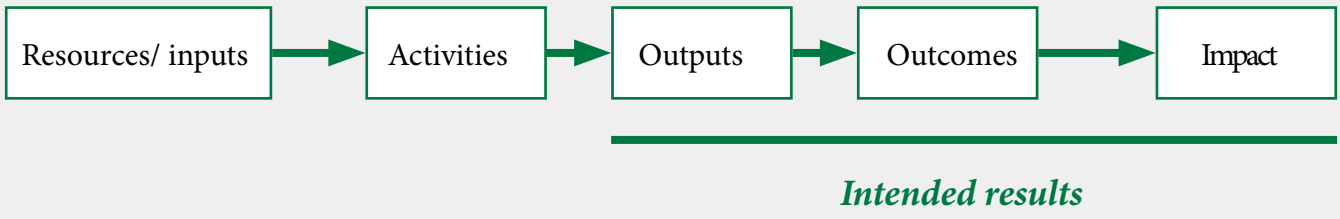
In the evaluation of school health promotion programmes for a general health purpose or for the prevention of obesity, randomized controlled trials might not be appropriate for several reasons (Stewart-Brown, 2001).

Randomized controlled trials normally focus on single interventions, whereas health promotion programmes are usually multifaceted. Furthermore, beyond the impact on physiological measures, valid and reliable pre-tested measures of emotional, mental and social well-being would be required. Finally, empowerment is a central issue in health promotion and may be difficult to evaluate.

For the whole project planning process, and for the evaluation in particular, using logic models or frameworks has become very common. A guide to development of such a model is available (Kellogg Foundation, 2004). For any programme or intervention, a specific logic model needs to be developed. The process of developing the logic model can enhance community participation and capacity. Because it is a visual tool, the logic model can also be a strong tool in communicating with diverse stakeholders involved in the programme.

The logic model is a systematic and visual way of representing the relationships among the resources required for the programme, the activities, and the results that the programme is intended to achieve. The inputs or resources include the human, financial, organizational and community resources needed to implement the activities. Activities are the processes, tools, events, technology and actions that are planned to bring about the expected results. The results include outputs, outcomes, and impact. The outputs are the direct products of programme activities, such as the targets of services delivered by the programme, for instance, the type of training and the persons trained. The outcomes are specific changes in participants' knowledge, attitudes and behaviours corresponding to specific objectives of the programme. Short-term outcomes should be achieved within 1-3 years, and longer-term outcomes, within 4-6 years (Kellogg Foundation, 2004). The impact corresponds to long-term goals of the programme at the level of participants, and also organizations, communities and systems. The impact often occurs after the completion of the programme, and it may occur within 7 to 10 years. 'Results-based management' as previously used by the Canadian International Development Agency (CIDA) for the design, monitoring and evaluation of its projects, uses a logic framework as a tool. A generic representation of a logic model is provided in Box XIII.

Box XIII. Basic logic model or framework for programme evaluation



8. POLICY AND INTERVENTION PROGRAMMES TO PREVENT OBESITY IN CHILDHOOD, WITH PARTICULAR FOCUS ON DEVELOPING COUNTRIES

8.1 Strategic and policy issues

The galloping growth of obesity worldwide, including childhood obesity, and the relative lack of success of treating obesity once it is established, point to the importance of prevention early in life. Furthermore, the prevention of obesity contributes to the prevention of other nutrition-related chronic diseases, including type 2 diabetes, cardiovascular disease, and several types of cancer.

Until recently, individual health behaviours were over-emphasized and the influence of policy and of the physical and social environment tended to be neglected. There is at present increased emphasis on environmental exposures that contribute to a positive energy balance, i.e., excessive food intake and limited physical activity (Cummins & Macintyre, 2006). It is widely agreed that action is urgently needed. The Prevention Group of the International Obesity Task Force (IOTF), now merged with the International Association for the Study of Obesity (IASO) published a framework for translating obesity prevention evidence into action (Swinburn et al, 2005), which addresses issues of contextual and policy relevance. Five key policy and programme issues form the basis of the framework:

1. Building a case for action on obesity
2. Identifying contributing factors and points of intervention
3. Defining the opportunities for action
4. Evaluating potential interventions
5. Selecting a portfolio of specific policies, programmes and actions.

Issue 4 was found to be the most problematic because of the lack of data on the effectiveness of interventions. Indeed, there is a critical research need to document the merits of various intervention portfolios, and to develop consistent indicators to ensure that comparisons of programme outcomes can better inform best practice (Flynn et al, 2006). The IOTF [now the IASO] also emphasized that modelling (using logic models and theories as described in Chapter 7), and expert and stakeholder judgment are better contributors to the evidence base for guiding obesity prevention than are the randomized controlled trials. Furthermore, actions which are not bringing about effective outcomes in themselves, but are essential for impact, including training, research and monitoring, need to be undertaken.

Policy and environmental approaches attempt to modify the social, regulatory and physical environments so that individuals adopt the intended behaviours to prevent obesity. Such approaches may be particularly well-suited for children and adolescents as they are in the process of shaping their own behaviours, they spend a good part of their life in a few settings that are amenable to environment or policy change, and their vulnerability justifies 'protective' actions (Robinson & Sirard, 2005).

Healthier lifestyles and environments are key conditions for halting the obesity epidemic, beginning in childhood. However, the requirements are not the same in all settings. In order to re-orientate the nutrition transition in developing countries, it is important that healthy lifestyles become the cultural norm among those in the higher socioeconomic status groups so that they serve as role models.

In low-income developing countries, obesity is still considered a problem of the affluent, although it is rapidly increasing in nearly all population groups, particularly in cities. A paradigm shift is needed in order to eliminate the myth that chronic diseases are diseases of the rich (Ezzati et al, 2005). As previously stated, several developing countries are now faced with a double nutritional burden, that is, persistent nutritional deficiencies (undernutrition) combined with the increasing rate of nutrition-related chronic diseases such as obesity ('overnutrition'). The challenge is to concurrently address nutritional deficiencies and imbalances, by promoting a diet which is at the same time adequate to meet the needs, and 'prudent' to prevent chronic diseases. To our knowledge, South Africa is a pioneer in implementing policies and programmes that address both sides of the nutrition problem (Vorster et al, 1999).

Whether in developed or developing countries, supplementary feeding programmes, including school-lunch programmes, may be appropriate in order to contribute to better nutrition and scholastic performance, particularly among low-income groups. However, targeting children who need the supplements is required in order to prevent that such programmes contribute to the rise of obesity in childhood, as observed in Chile (Uauy & Kain, 2002). Similarly, in the United States, a study showed that making universal free school breakfast available in elementary schools did not change the rate of skipping breakfast and meant that a small percentage were eating breakfast at home and at school, which may not be warranted given that mean energy intake exceeded the requirements (Crepinsek et al, 2006).

A workshop was convened by FAO in 2005 to review the findings of country case studies on the double nutritional burden and to draft recommendations to address it (FAO, 2006). Lists of recommended solutions may be helpful for health and nutrition professionals to consider. Eating habits strategies that were deemed particularly appropriate for addressing overweight/obesity in children and adolescents included:

- Promote the eating of a healthy breakfast at home
- Promote the bringing to school of healthy meals and snacks prepared at home
- Promote the sale of healthy foods in the school environment (shops, canteens, vendors)
- Reduce children's exposure to unhealthy food advertising and vending
- Implement teacher – child – parent nutrition education
- Promote community involvement in healthy eating at schools
- Eliminate the sale and marketing of soft drinks in school environments
- Promote consumption of dairy products
- Promote the eating of a variety of animal foods
- Make fruits and vegetables attractive and tasty.

The workshop also recommended strategies related to physical activity:

- Increase awareness of the importance of physical activity (PA) among teachers, parents and students
- Increase time spent on PA in schools and at home
- Provide safe protected spaces for PA near the home
- Promote sports days and other exercise events organized by schools/communities
- Make PA an active part of school curricula
- Provide incentives for physical fitness in children
- Increase awareness of the detrimental effects of sedentary activities such as television viewing among teachers, parents and students
- Encourage family exercise or participation in PA activities.

Childhood should be a priority, but this implies that action is also taken at other stages of the lifecycle, ensuring, for instance, that women have an adequate BMI when they enter pregnancy, and that they have adequate but not excessive weight gain in pregnancy. As previously stated, it is known that both low and very high birth weights are associated with enhanced obesity risk, likely because of insulin resistance (Lusting, 2006). Additionally, the promotion of exclusive breastfeeding for the first 6 months of life, coupled with appropriate complementary food thereafter, and the prevention of excessive weight gain from the age of 2 years onwards, are other important strategies for obesity prevention.

School-based programmes appear particularly attractive for the prevention of obesity. In low income countries, obesity prevention may be relevant primarily in cities. Schools need to enact coherent food, nutrition and physical activity policies, and prevent the pervasive influence of commercial marketing of industrial foods where appropriate. Regular and frequent monitoring of body weights is also required, and this is feasible in schools. Nutrition promotion must be the pillar of an overall strategy to address obesity in school children and adolescents.

Home- and community-based interventions, and other population-based interventions, are also relevant, although they are still scanty (Flynn et al, 2006). Moreover, targeting both, children and their parents or caregivers may be more effective than implementing obesity interventions for children alone (Seo & Sa, 2010). More research on these types of interventions is warranted to appraise their effectiveness. Additionally, policy would have to deal with population-wide food issues such as advertising, labelling and pricing (and tax), as well as processed food composition, for instance, their salt, sugar and trans fatty acid content. A 'whole of government' approach is necessary in order to involve all relevant sectors in an upstream and integrated approach for the prevention of obesity, including education, sports and city planning, among others (Sacks et al, 2009; Dietz et al, 2009).

As previously stated, in low and middle income countries, it is important to address the increasing double nutritional burden, that is, malnutrition (undernutrition and specific micronutrient deficiencies) and over-nutrition (FAO, 2006). However, specific micronutrient deficiencies are more likely to be encountered than general undernutrition among school-children and adolescents in stable populations, as opposed to displaced or refugee populations, and to under-five children. Poverty reduction strategies should also address the double nutritional burden and integrate obesity prevention. Nutrition supplementation programmes for children may need to be adjusted, however, so as not to contribute to obesity, as was observed in Chile (Uauy & Monteiro, 2004).

An ecological approach is needed in all cases, with action not only at the school level, but also at the community and government level, and even at the international level. The WHO School Policy Framework on Healthy Eating and Physical Activity recommends that schools and communities work together on strategies that promote health information, improve health literacy, and promote healthy diet and daily physical education (WHO, 2008a). Among others, it is particularly important that food marketing targeting children be regulated where relevant in view of its likely contribution to increasing rates of obesity in children and adolescents (Platt Majoras et al, 2006).

8.2 School-based strategies used internationally

8.2–1 Health promoting schools

The WHO launched a global School Health Initiative in 1995, designed to improve the health of pupils, school personnel, families and other members of the community through schools. The goal of the School Health Initiative is to increase the number of "Health Promoting Schools". Strategies of the Initiative include research to improve school health programmes, building capacity to advocate for improved school health programmes, strengthening national capacities, and creating networks and alliances for the development of health promoting schools.

What is a health promoting school? It is one that constantly strengthens its capacity as a healthy setting for living, learning and working. Among other features, it strives to provide:

- a healthy environment
- school health education
- school health services
- school/community projects and outreach
- health promotion programmes for staff
- nutrition and food safety programmes
- opportunities for physical education and recreation
- programmes for counselling, social support and mental health promotion.

A health promoting school also engages all stakeholders in its efforts to make the school a healthy place: health and education officials, teachers, students, parents, health providers and community leaders. An award system has been proposed as a means of giving recognition to schools that are promoting health.

Health promoting school models, programmes and networks have been designed in developed and developing countries. Guidelines for health promoting schools in the Western Pacific Region were developed by WHO (1996). In this document, a framework for action is proposed. It consists of components and checkpoints that are developed in six areas reflecting the major elements of health-promoting schools:

1. School health policies
2. The school physical environment
3. The school social environment
4. Community relationships
5. Personal health skills
6. Health services.

Much can be done through health promoting schools to improve dietary and physical activity behaviours, and prevent childhood obesity. In the policy area, a health promoting school has a policy on healthy food, for instance. Action is taken to ensure the availability of healthy food for pupils. In the area of personal health skills, the curriculum should be designed to improve students' understanding of health issues, including nutrition, disease- prevention and hygiene, physical activity, and tobacco and drug use prevention. In the area of health services available to students, screening, referral and other measures for nutrition- related problems such as underweight, micronutrient deficiency signs and also obesity, should be provided.

The effectiveness of the health promoting school approach reportedly varies, according to a review commissioned by WHO/Europe (Stewart-Brown, 2006). School-based programmes which focused on promoting healthy eating and physical activity (and mental health) appeared to be amongst the most effective. However, the report dealt with systematic reviews of controlled trials. Sheperd et al (2002), in a review of 7 controlled studies on interventions designed to promote healthy eating and physical activity, reported that most programmes were effective and that impact was more apparent on older students and on girls, that teacher training was important, and that effective programmes adopted whole school approaches and provided healthy food in canteens. The approach could impact not only on health-related behaviours of students, but also on the social and physical environment of the school in terms of staff development, school lunch provision, exercise programmes and social atmosphere.

8.2–2 Nutrition–Friendly Schools Initiative

A strategy of WHO is the Nutrition-Friendly Schools Initiative (NFSI), which was developed as a follow-up to the WHO Expert Meeting on childhood obesity, held in Kobe (Japan) in 2005. The NFSI aims to provide a framework for designing integrated school-based intervention programmes which address the double-burden of nutrition-related ill-health (undernutrition and micronutrient deficiencies on the one hand, obesity and co- morbidities on the other), building on the on-going work of various agencies and partners, including

UNICEF and FAO. It is very similar to the health promoting school strategy, but it focuses on nutrition, more specifically the double nutritional burden, through nutrition and physical activity programmes. Additionally, it applies the concept and principles of the Baby-friendly Hospital Initiative. For instance, a designation system and monitoring process for nutrition-friendly schools is developed based on the schools meeting a set of criteria. Additionally, the approach emphasizes local ownership and community involvement, as these are key elements for the effectiveness of interventions. An initial step consists of the school setting up a committee with teachers, parents, students and other community representatives in order to undertake a self-assessment of the school nutrition and health situation and decide on priority action with respect to the five components of the initiative:

1. A school nutrition policy
2. Sensitization and training on the policy
3. Integration of nutrition in the school-curriculum
4. A sustaining food and hygiene environment
5. Health and nutrition services at school.

Experience with this approach is still limited, although a pilot project in Benin and Burkina Faso (West Africa) was successfully implemented with promising results (Delisle et al, 2013).

8.3 Intervention programmes: their effectiveness

In general, successful community-based interventions for childhood obesity prevention should have multiple components that are designed for and implemented according to the local context (WHO, 2012). Obesity prevention interventions should always address both diet and physical activity. Doing this not only maximizes the impact of the intervention, but it is also cost-effective (Nguyen et al, 2011; Waters et al, 2011; Gortmaker et al, 2011).

Most controlled studies on obesity prevention in school-age children come from high income countries, but many are also relevant for developing countries. This is the rationale for describing some of them.

In developed countries, several large intervention trials have been conducted among youth to improve dietary patterns to prevent cardiovascular disease (i.e., the CATCH study - Child and Adolescent Trial for Cardiovascular Health; the Stanford Adolescent Heart Health programme), and to prevent cancer (5-a-Day programmes). There are also weight loss interventions for overweight adolescents (Powell Stuart et al, 2005). There are also quite a few interventions that were specifically designed to prevent obesity in school children and adolescents.

Evidence-based behavioural strategies to curb obesity in childhood in the USA have been reviewed (Sherry, 2005). These include: promoting breastfeeding; promoting physical activity; reducing television/video viewing; increasing fruit and vegetable consumption; reducing consumption of sugar-sweetened drinks; and, reducing portion sizes. There is more evidence for the effectiveness of the first three strategies, but it was concluded that more research was needed on all these strategies.

In Finland, an early obesity prevention trial (STRIP) was found to be effective (Hakanen et al, 2006). At 7 months of age, infants were randomized to a control group or an intervention group. The intervention group received general information of lifestyle counselling from a dietitian and physician once every one to three months until 2 years of age, followed by visits twice a year thereafter. The family control group were seen twice and received routine information provided in well-baby clinics and school-health programmes. Some 1000 families took part in the study. The impact of repeated and individualized dietary and lifestyle counselling on overweight development in children during their first 7-10 years of life was assessed. Beginning at the age of two years, there were consistently fewer overweight girls (but not boys) in the intervention group, and at the age of ten years, 10% of children were overweight, compared to 19% in the control group.

Haby et al (2006) assessed the cost-effectiveness of obesity interventions in children and adolescents using as indicators of health benefit the BMI units saved and disability-adjusted life years (DALYs) saved. The decrease in television advertizing of high-fat and/or high-sugar foods and drinks to children may have the greatest benefit. Multi-faceted school interventions with a physical activity component were also at the top of the health benefit list.

There have been several large reviews of intervention trials to reduce obesity in children in recent years (Doak et al, 2006; Flodmark et al, 2006; Summerbel et al, 2006; Ng et al, 2005). Most of the interventions were school-based and nearly all of them were carried out in industrialized countries. In the Cochrane review (Summerbel et al, 2006), only 15% of the 32 interventions included showed effect on obesity markers. The conclusion was that such programmes have no impact. It is argued, however, that broadening the definition of evidence should be sought for health promotion interventions, and that the process itself may be as important as the outcomes. Other than reduced obesity, outcomes suggesting success may be improved behaviours (dietary intake, physical activity), and satisfactory implementation.

Another review of 24 controlled trials of health promotion or obesity prevention (Doak et al, 2006) gave more positive results, with 68% of them reportedly effective in reducing BMIs or skinfolds. Programmes focused on reducing television time were effective in reducing both BMIs and skinfolds (2 out of 3 were in the USA). The reviewers noted that the effective interventions were less likely to target the physical environment or family-level factors, and to include the broader community, which again suggests that other endpoints than body fat may be important. They also recommended reporting on underweight prevalence, which is particularly relevant when attempting to address the dual nutritional burden in developing country children. The systematic review by Flodmark et al (2006) concluded that 41% of the 39 studies had a significant positive effect on obesity (or 40% of the 33,852 children studied). In this and other reviews, no study reported any adverse effect in terms of eating disturbances, low self- confidence, or stigmatization of obese children. Another review (Ng et al, 2005) included 14 school-based programmes for the prevention of obesity and type 2 diabetes, all of which in industrialized countries except for one which was carried out in Chile. The review reported that the programmes were only modestly successful at reducing obesity and changing health behaviours. It concluded that addressing environmental, cultural and economic factors that contribute to obesity is necessary, and from a programme perspective, that family and community involvement may help maximize programme participation. Sustainability and reach as well as population impact need to be assessed with a judicious choice of indicators, and using the most appropriate but feasible design – quasi-experimental, for instance, meaning that a control group is available for comparisons but without random assignment to treatment or control group. In programmes including a physical exercise component, indicators of adiposity should be measured in addition to BMI, as body mass may increase while fat mass decreases. A smaller and earlier review (Bautista-Castano et al, 2004) suggested that nutrition education and the promotion of physical activity together with behaviour modifications, decrease in sedentary activities and the collaboration of the family could be the determining factors in the prevention of childhood obesity.

Two interesting projects have specifically targeted adolescents. The first, 'Weight Gain Prevention', took place in the Netherlands (Kremers et al, 2005). It began with a systematic identification of the environmental and behavioural determinants of weight gain (diet and activity) as well as the psychosocial determinants of these behaviours. Interventions were planned using the intervention mapping protocol and included a thorough evaluation scheme. The intervention programme consisted of a classroom-based component and an environmental component. The intervention focussed on four health behaviours: 1) reduction of consumption of sugar-sweetened beverages; 2) reduction of energy intake from snacks; 3) decrease in sedentary behaviours; and 4) increase of physical activity (active transportation and sports). The programme resulted in beneficial effects on the adiposity in girls and consumption of sugar-containing beverages in both boys and girls in both the short and long terms. A similar school-based programme, the ENERGY project, is currently being implemented across Europe for the prevention of overweight (Brug et al, 2010). The second project is Planet Health, a school-based obesity prevention programme conducted in New-England, USA (Austin et al, 2005; Perry, 2005; Gortmaker et al, 1999). The intervention focused on more fruits and vegetables and low-fat options, increased physical activity and less television viewing. Results indicate that the programme was effective in curbing obesity in girls and in reducing

television watching in boys and girls. Planet Health has been scaled up and demonstrated effectiveness, feasibility, acceptability, and sustainability in a public school environment.
In a Cochrane meta-analysis (Waters et al, 2011) including 37 studies and 27,946 children, with the majority in the 6 to 12-year range, interventions were predominantly based on behaviour change theories. The review showed that the interventions were effective in reducing pre-to post-intervention by -0.15 BMI z-score units, relative to the change in control groups. Obesity prevention interventions could therefore be effective at reducing adiposity, even though firm conclusions about the best interventions for effective behaviour change cannot be drawn because of the variety of approaches used, combined with the heterogeneous measures used to assess intervention impact.

Another review described the comparative effectiveness of interventions to prevent obesity in US children and adolescents aged 2 to 18 years (Wang et al, 2013). It included 104 randomized controlled trials, quasi-experimental studies, and natural experiments assessing school-based interventions conducted over periods of 6 months up to 6 years. The studies provided convincing evidence, although moderate, that school-based interventions with either home or community components contribute to obesity prevention.

In Canada, 40 studies were included in a review (Public Health Ontario, 2013) which concluded that interventions for childhood obesity prevention were more likely to be effective if they targeted both physical activity and healthy eating, involved parents, were designed to be culturally sensitive, had effective staff training and sustainability, used participatory activities and training in behaviour change techniques, were done in collaboration with community programmes or facilities, increased sessions of physical activity throughout the school week, modified the food environment of schools to improve nutritional quality of school foods, and were set within environments and cultures that supported healthy eating and physical activity.

Although most school-based programmes subjected to evaluation are from industrialized countries, there are examples of success in developing countries. In a review of 20 interventional Chinese studies focusing on the effect of physical activity, dietary intervention, and health education in obesity in children, 17 studies were reported to be effective in reducing obesity (Gao et al, 2008). In Singapore, the national healthy lifestyle, school-based programme, 'Trim and Fit', has had some success, although it was not a controlled intervention trial but a programme (Toh et al, 2002). There was a modest reduction of obesity of around 15%, while over the same period, adult obesity increased from 5.1% to 6.0%. It included a variety of changes in the school environment: exercise programme, nutrition counselling, weight monitoring, choice of low-calorie foods and more fruits and vegetables in the school canteen, seminars and meetings for parents of overweight children, etc.

In Chile, a controlled intervention study for the prevention of obesity involving more than 3500 primary school children addressed diet/nutrition, physical activity, tobacco control and a healthy environment (Kain et al, 2004). The diet and nutrition component included: a child-friendly classroom nutrition education programme (5-11 hours); meeting with private owners of school kiosks (equivalent to vending machines) in order to encourage them to provide healthier snacks; meetings with parents for their involvement; and a healthy snack contest. The physical activity intervention consisted of the application of an adapted version of the CALC tool (Canadian Active Living Challenge) designed for children aged 6-18 years, an extra 90 minutes per week for team sports, and one active recess per day. Primary outcome measures pertained to anthropometric status (BMI and triceps skinfold, waist circumference) and physical fitness (cardio-respiratory fitness and flexibility). It was found that while the intervention had a marked impact on physical fitness of both boys and girls, it only had an effect on adiposity-related parameters (BMI and waist circumference) in boys, possibly because of their better compliance with the physical activity component. In the intervention group, the obese/overweight lost weight (expressed as BMI Z-score), a highly desirable outcome, while the underweight gained weight. However, there was no change in the food offered in the school kiosks, which was attributed to the absence of clear incentives to provide healthier choices.

A pilot programme developed for the prevention of obesity in a large aboriginal school of Quebec is described in the following box (unpublished data). A major feature of the programme is the participatory approach to the design, implementation and evaluation, and the combination of qualitative and quantitative methods for the evaluation. However, this was a relatively small project and its long-term impact could not be assessed.

BOX XIV. SCHOOL-BASED PROGRAMME FOR THE PREVENTION OF OBESITY AND DIABETES IN ABORIGINAL PRE-ADOLESCENTS AND ADOLESCENTS IN QUEBEC CANADA (Delisle et al, 1996)

Background and formative research

Epidemiological studies revealed a high rate of type 2 diabetes and obesity in the two largest Algonquin communities of Quebec (Delisle & Ekoe, 1993; Delisle et al, 1995), as reported in several other aboriginal populations. The results of these epidemiological studies led to a school-based preventive intervention. It was developed based on formative research, which involved workshops with pupils and informal discussions with teachers. Workshops were held with a random sample of 10 pupils (boys and girls) in each of the 3 randomly selected classes to benefit from the intervention programme. Activities included focus groups, games, and individual questionnaires. Focus group discussions and games were intended to gain a better understanding of their perceptions and beliefs relative to food, of their food preferences and motivations for choice, and of their interest in nutrition. Individual questionnaires pertained to their use of pocket money to buy food and snacks, and to perceptions on their body size. We discussed with teachers the food habits of the school-children and underlying factors influencing their choices, we documented on-going or recent nutrition activities in the school, and we asked for suggestions for the nutrition education programme being designed.

Programme design and content

Three specific objectives were defined based on formative research results:

- To reduce consumption of fat and sweets;
- To increase consumption of high-fibre foods, in particular fruits and vegetables;
- To improve the nutrient density of snacks.

The programme incorporated the principles of Social Learning Theory: development of relevant skills, motivation for change through demonstration of the benefits, and appropriate reinforcement using among others targeted behavioural changes as challenges and competition between classes in meeting these challenges throughout the programme. A play mode and the active involvement of pupils (and mothers) were key strategies.

The content of the programme consisted of 7 weekly sessions of 1-2 hours duration during school time, including one with mothers. Many involved actual food preparation in the school kitchen or practical exercises. The programme manual was published (Delisle et al, 1996). Programme themes were:

- "Diabetes in the community" (with a testimony of a community member)
- "A good start with a healthy breakfast" (choosing high-fibre cereal);
- "Preparing/buying better snacks" (preparation of Muesli; finding healthy snacks in the local convenience store);
- "Why fruits and vegetables are important?" (tasting of less common fruits and vegetables; preparation of vegetable "dips");
- "What is a healthy weight'?' (calculating one's BMI);
- "What is a well-balanced meal?" (with mothers, menu planning exercise);
- "Appropriate serving sizes".

A tour of the local supermarket with parents was also scheduled to help parents identify good choices, in terms of price and nutrition, available in the food store.

The three "challenges" for the pupils were: to have a healthy breakfast every morning; to eat "green" snacks; and to eat at least two servings of vegetables and two servings of fruit everyday.

Programme evaluation

We used 3 sets of tools: a self-administered questionnaire administered at the beginning of the programme and then 3 months following the last programme activity; individual (anonymous) responses regarding progress in meeting the challenges; and follow-up focus groups with pupils and individual interviews with participating parents. The individual questionnaires pre- and post-programme were also filled by pupils of "control" classes, who had not been exposed to the intervention.

The results were promising; the children reporting enjoying the programme, in particular cooking and tasting; they would like more of it, and they declared some changes in their eating patterns, changes which were confirmed in the individual responses on the challenges, and in the pre-post questionnaire. The increased consumption of fruits and vegetables was the most important (and significant) change. It is not known, however, whether the changes that were apparent at 3 months following the programme were sustained.

9. CONCLUSIONS

Obesity rates continue to increase worldwide. High or increasing rates of overweight and obesity in children and adolescents have been reported in all developing regions, reflecting the societal lifestyle shifts towards excess energy intake along with increasing physical inactivity. Such shifts, typical of the nutrition transition, are fuelled by globalization, urbanization and technological developments. The nutrition transition can and must be halted, if a massive epidemic of obesity and co-morbidities is to be avoided in developing countries. Prevention is timely, in parallel with further research on the determinants of childhood obesity, its definition across cultures, and the effectiveness of intervention strategies in developing country settings. Health and nutrition workers need to be involved in preventing this pandemic while also addressing persistent nutritional deficiency problems, which represents a daunting challenge. Obesity prevention was already identified as an immediate action priority by WHO in 2000, through strategies to address the societal and environmental causes of obesity by several sectors including transport, environment, health, food and nutrition, trade, industry, and others. Obesity can only be tackled if programmes do not only address behaviours, but also the environments conducive to healthy or unhealthy behaviours. Therefore, a comprehensive ecological approach is needed.

Children and adolescents should be primary targets for prevention. Investing in the future of children's health is urgently needed. School-based programmes appear to be particularly relevant. Obesity prevention is best integrated into existing school-based programmes for the promotion of healthy living, and physical activity needs particular emphasis. Monitoring and evaluation are warranted in order to ascertain whether the positive impact of intervention programmes is sustained, as well as for advocacy purposes.

Political will and commitment to action is necessary, which calls for sensitization of decision makers at all levels. Advocacy is essential for this purpose, and specific tools still need to be developed. Unless obesity is perceived as a serious and costly health problem, preventive action will indeed remain elusive. Emphasis on the child obesity problem may be a convincing argument. Decision makers need to allocate sufficient financial resources to deal with the obesity problem, ensuring that national policies are conducive to promoting healthy behaviours, and encouraging intersectoral collaboration to ensure a healthy food supply and access for all to adequate and healthy foods. The importance of ensuring that people have sufficient physical activity and have access to the means for so doing is not to be underestimated either. Involving all stakeholders in obesity prevention is crucial to the success of programmes, and yet it is not a simple undertaking. "The art of preventing obesity involves the blend of review, risk, and political negociation" (Lobstein, 2006). What is most challenging in low and middle-income countries is the urgency of preventing obesity while also tackling the problem of malnutrition. Again, the school setting is likely the most appropriate to address the dual burden of malnutrition, but interventions are needed at different stages of the lifecycle, beginning with girls, in order to break the intergenerational cycle of malnutrition and its impact on vulnerability to obesity and other chronic diseases.

The responsibility for action lies in the hands of many stakeholders, including health and nutrition professionals. It is hoped that this manual will be useful and encourage them to engage in obesity prevention.

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APPENDIX I. PRACTICAL TIPS FOR TAKING ANTHROPOMETRIC MEASURES

Weight and height

Weights and heights are the basic measurements needed to compute BMI for age and sex, which is used as indicator of overweight and obesity (as well as underweight) at school age (5 – 19 years).

- **Measurement of weight:**

Weight should be measured to the nearest 0.2 kg in light indoor clothing without shoes. The scale should be set on a flat surface. In clinical or laboratory settings, weight is measured using a levelled platform beam scale with moveable weights, the measurer facing the subject. The beam is graduated so that it can be read from both sides, thus allowing the measurer to move the weights without reaching around the subject. The subject stands still over the centre of the platform with the body weight evenly distributed between both feet. If possible, standardizing the clothing reduces the risk of error.

In field studies, a spring scale, tested daily for accuracy and calibrated with a set of standard weights, can be used (Paradis et al, 2003). In the validation study performed for the Canadian Heart Health Survey (MacLean et al, 1992), no significant difference in the precision of measurement was shown between levelled platform beam scale and spring scale.

- **Measurement of height:**

Height should be measured using a stadiometer, i.e., a vertical board with an attached metric rule and a horizontal headboard that can be brought in contact with the apex of the head. Fixed and portable models are available. A standard measuring tape can also be used with a triangular level with a 90° angle placed against the wall and the head of the subject, ensuring that the head remains in the Frankfort horizontal plane. If the floor is carpeted or uneven, place a 2 cm wooden board on the floor against the wall and measure from the top of the wooden board with the subject standing on it.

Subjects should be barefoot and wear light clothing so that the positioning of the body can be seen. Subjects stand straight against the wall, the shoulder blades and buttocks in contact with the wall or the vertical board. In some subjects this positioning is difficult to maintain naturally. In this situation, the buttocks and the heels or the back of the head should be placed against the wall. The weight of the subject is distributed evenly on both feet, both heels touching the wall or the back of the vertical board. The arms should hang freely on both sides with palms facing the thighs. Headpieces have to be removed and it may be necessary to flatten the hair on top of the head. Height is recorded to the nearest millimeter (0.1 cm) during maximal inspiration (Heyward & Wagner, 2004; Quebec Child and Adolescent Health and Social Survey, 2002).

BMI (Body Mass Index)= weight (kg)/ height $(m)^2$.

Circumferences

- Measurement of waist circumference:

Ideally, the measurement should not be made over clothing but if requested for religious or cultural reasons, clothing should be light and standardized. The subjects stand erect with the abdomen relaxed, the arms at the sides facing the thigh and the feet together. The measurer places the tape (should not be stretchable) around the waist in a horizontal plane. Waist circumference has usually been measured at the smallest circumference of the trunk or at the level of natural waist. This lacks precision and anatomically waist measurement should be performed at mid-distance between the lowest floating rib and the iliac crest, as recommended by WHO (2008b). Measurement is taken at the end of a normal expiration and recorded to the nearest 0.5 cm.

Skinfolds

Triceps and subscapular skinfolds are qualifiers of the BMI that should be used to confirm obesity or excess body fat versus overweight or high lean body mass status for clinical or research purposes. Skinfold measurements should always be performed on the right side of the body for better standardization, unless a scar or an injury at the measurement site is present (see Figure 2). Measurements are performed to the nearest 0.1 cm according to the method described by Heyward & Wagner (2004). Measurement can be performed over standardized clothing if necessary: when this is done, the thickness of the garment is measured with the calliper and subtracted from the overall measurement (skinfold plus garment) before recording. Subjects stand with their feet together and arms at their sides, and relax their muscles as much as possible.

Metal or plastic callipers can be used and the choice depends on the desired level of accuracy and precision. High-quality callipers such as Harpenden, Lange and Holtain exert a constant pressure of ≅ 10g/mm^2 and are more precise than the plastic callipers: 0.1 mm for Harpenden or Holtain, 0.5 mm for Lange, and 1 mm for plastic callipers. Harpenden callipers are known to be harder to manipulate. Lange callipers are often preferred in studies in children and elderly because of the smaller size of the jaws. Plastic callipers have non-consistent tension throughout the range of measurements, smaller measurement scale (0-40 mm) and less consistency when used by inexperienced technicians (Heyward & Wagner, 2004).

The following 10 guidelines (Box XV) are essential for appropriate skinfold measurements.

Box XV. Guidelines for appropriate skinfold measurements

1. Take all measurements on the right side of the body- unless an abnormality (scar, injury...) is present.
2. Determine the exact site of measurement: refer to anatomical characteristics and reference method.
3. Always take a minimal skinfold: a fold of skin plus the underlying fat is grasped between thumb and forefinger with the back of his/her hand facing the measurer.
4. Follow the natural line of the fold: horizontal, vertical or diagonal.
5. Apply calliper at a distance of approximately 1 cm from exact site of the fold.
6. The contact faces of the calliper should be placed at the bottom of the fold and should be at an angle parallel to the folds
7. The jaws of the calliper should be perpendicular, at right angle, to the surface of the body.
8. Maintain light pressure with the fingers holding the fold while releasing completely the trigger of the calliper and taking the measurement.
9. Apply calliper and count 2 to 3 seconds before taking the reading to give time to the pressures inside the fold to equilibrate (See graph).
10. Take two measures. If difference > 0.4 mm, then take a third measure. Choose the two measures that most closely match each other and keep the mean value.

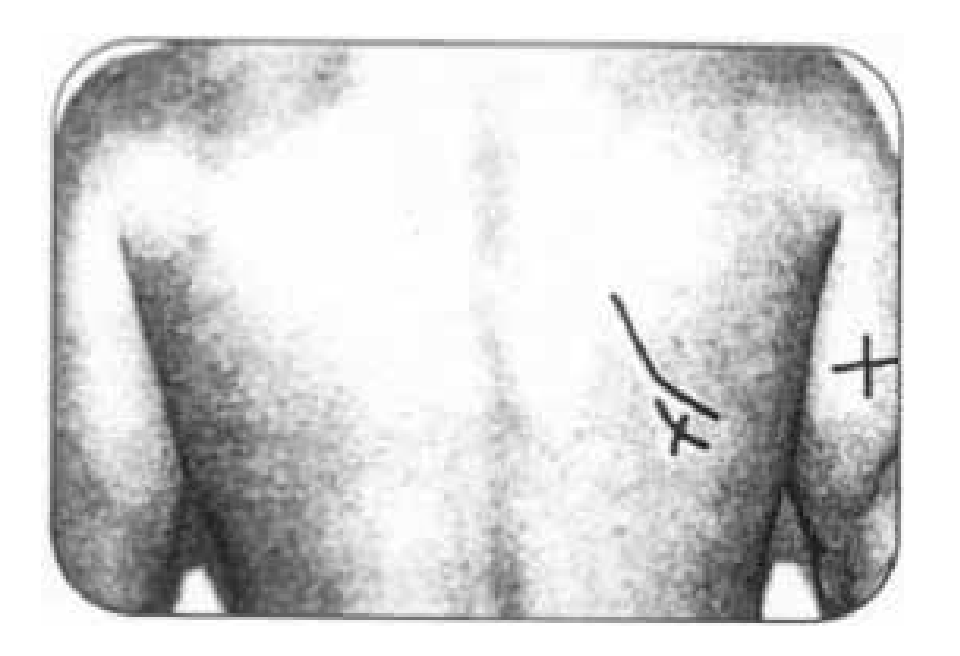
- Measurement of triceps skinfold:

Triceps skinfold is measured vertically on the midline of the arm, at mid-distance between the lateral projection of the acromial process (tip of the shoulder) and the inferior margin of the olecranon process (tip of the elbow). The mid-distance is measured with a tape on the lateral aspect of the arm with the elbow flexed at 90°, palm facing up. The midpoint is marked on the lateral side of the arm. The skinfold is lifted 1 cm above the marked line on the posterior aspect (back) of the arm and the calliper is applied at the marked level.

- Measurement of subscapular skinfold:

The skinfold is measured diagonally along the natural cleavage line of the skin below the scapula inferior to the inferior angle of scapula with the calliper applied at 1cm laterally (see Figure 2).

Figure 2. Measurement sites, subscapular and triceps skinfolds (Houde-Nadeau & Ledoux, 2003)



APPENDIX II. BIOELECTRICAL IMPEDANCE ANALYSIS (BIA)

There are different approaches to the use of impedance for clinical or field uses: traditional BIA using whole body, tetrapolar and multi-frequency approach to estimate total body water and fat free mass in healthy subjects with normal hydration status and normal fluid distribution; segmental BIA used to measure regional or segmental intracellular water; multi-frequency BIA used to monitor changes in extracellular/intracellular water or ECW/Total Body Water in clinical populations; and finally upper body (hand-to-hand) or lower body (foot-to-foot) BIA used to estimate percent body fat in healthy subjects with normal hydration status and normal fluid distribution.

In field studies, traditional BIA as well as upper or lower body BIA would be the ones to consider. Generally, lower body BIA also provides information on % water of the body which may explain help outliers in percentage body fat. Traditional BIA is more precise since it is a whole body measurement. Upper or lower body measurements provide interesting but less accurate results. Lower body BIA analyzer with a Tanita-type scale offers several advantages. Body weight and % body fat are measured at the same time. BIA scales are becoming less costly. Additionally, body position is correct since there are plates on the scale for the feet. Care is needed so that correct data on weight, height and physical activity level are entered as these impinge on the results. Additionally, it cannot be excluded that the equations upon which the % body fat is computed may not be appropriate for the study population. Tyrrell et al, 2001 (in Heyward & Wagner, 2004) derived a fat free mass prediction equation for children using lower body BIA analysis and Utter et al (1999) confirmed that the lower-body BIA method is similar in accuracy to the hydrodensitometry method for assessing changes in percent body fat over time.

The major points to consider for whole-body BIA are listed below.

Box XVI. Guidelines for whole-body bioelectrical impedance measurements

1. Take the measurement on the right side of the body
2. Clean the skin and electrode sites with an alcohol pad
3. Place the electrodes (as suggested by the manufacturer): (1) on the dorsal side of the wrist so that the upper border of the electrode bisects the styloid processes of the ulna and radius and the dorsal surface of the ankle so that the upper border of the electrode bisects the medial and lateral malleoli.
4. (2) at the base of the second or third metacarpal-phalangeal joints of the hand and foot. Ensure that the distance between the proximal and distal electrodes is at least 5 cm.
5. There should be no contact between the thighs or between the arms and trunk.
6. Choose the appropriate current velocity i.e., 50 kHz
7. The ideal environmental temperature: between 21 and 25° C.
8. Select the equation taking into account age, sex, ethnicity, physical activity and level of body fatness (approximation).
9. intense (hard) exercise/physical activity should be performed during the day before the measurement.
10. The subject should be in the fasting state since the night before, and the measurement should be taken at least 3 hours after waking up
11. Make sure that hydration status is standardized prior to measurement, i.e., a specific amount of water should be drunk prior to measurement. Standardize the time, for example: 1 hour, or take all measurements after voiding in the morning. No intense (hard) exercise /physical activity should be performed during the day before the measurement
12. The subject should be in the fasting state since the night before, and the measurement should be taken at least 3 hours after waking up
13. Menstruating period should be noted since water retention occurs at the pre-menstrual period.

Figure 3. Whole-body bioelectrical impedance analysis (BIA): position of the limbs and electrodes

APPENDIX III. EVALUATION OF PUBERTY STAGE

In field and epidemiological studies, defining puberty status, and therefore the phase of development, needs to be addressed since chronological age does not necessarily reflect the actual phase of maturation (Tanner's phase) of the adolescent. In the Quebec Child and Adolescent Health and Social Survey (Paradis et al, 1999), for instance, phase of puberty was determined from a previously validated questionnaire including questions on voice change and facial hair for boys, breast growth for girls and underarm and pubic hair for both sexes (National Longitudinal Study of Children and Youth, 1995). Questions used in the survey are outlined below. Validation of this questionnaire showed a 95% correlation between adolescent's estimation of Tanner's phase and the estimation by a medical professional.

Box XVII. Questions to evaluate puberty and sexual development among adolescents (Aubin et al, 2002)

1. Do you have any body hair (meaning underarm or pubic hair)?
- It has not yet started growing
- It has barely started growing
- It has definitely started growing
- I think it has stopped growing

If you are a male > Go to question 4

2. Have your breasts begun to grow?
- They have not yet started growing
- They have barely started growing
- They have definitely started growing
- I think they have stopped growing

3. Have you begun to menstruate (have periods)?
- Yes
- No

For males only:

4. Have you noticed a deepening of your voice?
- It has not yet started changing
- It has barely started changing
- It has definitely started changing
- I think it has stopped changing

5. Do you have any hair on your face?
- I don't have any yet
- It has just begun to grow
- I already have quite a bit
- I think my facial hair has filled in and will remain the same

APPENDIX IV. 24-HOUR FOOD RECALL METHODOLOGY

The technique consists for a trained interviewer to ask subjects, or the parents or caretakers in the case of young children, to recall as thoroughly and accurately as possible everything the person ate and drank during the previous day. Detailed descriptions of all food and beverage items, including cooking methods and ingredients in the case of mixed dishes are recorded by the interviewer. For the respondents, estimating quantities is difficult; using local household measures (cups, spoons, glassses…) or else food models or pictures is recommended to assist in the estimation of serving sizes.

The interview protocol has to be standardized and pretested, and interviewers need to be carefully trained in order for 24-hour recalls to be as reliable as possible.

The "multiple-pass method" was developed in USA as a means of achieving greater accuracy in 24-hour recalls (see Conway et al, 2004). The five steps of the process are summarized below:

Step I: Quick list

The respondent lists without interruption all foods and beverages consumed on the day preceding the interview.

Step II. Forgotten foods

The interviewer uses a list of food groups to help the respondent complete his recall. The items of the list are:

- beverages, non-alcoholic and alcoholic beverages (coffee and tea are important to record for the sugar and milk that may be added)
- between-meal snacks
- sweets
- fruits and vegetables
- other items as locally defined which may easily be forgotten.

Step III: Time and occasion

The time of day each item was consumed and whether it was considered part of a meal or snack are additional details asked to the respondent.

Step IV: Detail cycle

The respondent is asked where the food and beverage items were eaten (or obtained if this information is deemed relevant), and item descriptions, quantities, times and occasions (meals, snacks) are reviewed.

Step V. Final review probe

A final probe question is asked for anything else consumed.

Since 24-hour recalls are used to estimate usual intakes, days where intakes are likely to be atypical or non-representative such as holidays and special events are preferably omitted. An additional question should be asked to make a note if for any other reason the recall day's intake was unusual. Another additional question refers to the use of vitamin/mineral supplements if relevant in a given context.

A form like the one in Table 7 may be used to record the details of the 24-hour recall:

Table 7. Recording form for a 24-hour dietary recall

Time of day	Meal/ snack	Place	Name of mixed dish/ food	Details	Ingredients of mixed dish	Quantity
7:00 AM	Breakfast	Home	Orange juice	Fresh, no sugar added		140 ml
	"	"	Bread	White baguette		¼
	"	"	Margarine	Fortified with vitamin A [Bradname]		5 g
11:00 AM	Snack	Street kiosk	Sandwich		White bread	2 slices
					Butter	2 tsp
					Processed cheddar cheese	1 slice
					Tomato	½
1:00 PM	Lunch	……..	……			

APPENDIX V. FOOD FREQUENCY METHODOLOGY

A food frequency questionnaire needs to be developed in consideration of the objectives of the study and suspected dietary inadequacies or imbalances in the specific study setting and population group. The second step includes determining the reference period and the food categories upon which the final analysis will be performed. The reference period is usually one week, although much longer periods are used in epidemiological studies on cancer, for instance. The third step consists of selecting the criteria for the analysis.

The first question to ask the participant is: "How many times do you usually eat ***Food X*** during a 7 day period (or a normal week)". For each food, mark an "X" in only one column. An example of a food frequency questionnaire, as used in the Health and Social Survey of Quebec Children and Youth (Paradis et al, 2003) is provided in Table 8. In other contexts, items such as green leafy vegetables, legumes, 'fast food', ultra-processed food items, soft drinks, etc., may be of interest.

Table 8. Record for a food frequency questionnaire

Foods	Frequency						
	Not once	Weekly			Daily		
		1-2 times	3-4 times	5-6 times	1-2 times	3-4 times	5 times or more
Milk (as beverage)							
Raw vegetables and salads							
Cooked vegetables other than potatoes							
Fruit(s) – fresh, canned, frozen or cooked							
Bread, bagel, pita or other types of bread a) White							
b) Whole-wheat (rye, 6-grain, etc.)							

A food frequency questionnaire can also include average serving sizes (semi-quantitative). If serving sizes are included, adding pictures of a normal serving size improves precision more than providing sizes in actual measures e.g. 2 cm X 2 cm X 5 cm.

The analysis of the food frequency questionnaire can be done in different ways. One method consists of categorizing the foods and looking for which categorization would be considered normal or adequate from a nutrition point of view. For example, in the 5 Francophone Country Survey (Lorenzo, 1999), France used the following 6 food categories:

1. Fruits, vegetables (including raw and cooked vegetables), soups
2. Milk products including milk, chocolate milk, yogurt, cheese, butter
3. Fish, chicken, sausages, processed meats, eggs, meats
4. Cereals, bread, crackers, rice, pasta, potatoes
5. Lemonade, sodas, soft drinks, sport drinks, cookies, cakes, candies, chocolate, ice cream
6. Fried foods, especially French fries and chips

Final interpretation of the data was based on the following criteria:

- Foods from groups 1, 2 and 4 should be consumed more often than once a day
- Foods from group 3 should be eaten once a day
- Foods from groups 5 and 6 should not be eaten on an everyday basis.

In a given setting, local food guide or dietary guidelines may help to define the adequacy of the frequency and serving size of food group consumption.