

Nutrition in adolescence – Issues and Challenges for the Health Sector

Issues in Adolescent Health and Development



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Preface

The overall purpose of this document is to present the factors and current thinking which underlie WHO's recommendations for the prevention of nutritional disorders in adolescents, and for their early detection, diagnosis and appropriate management. Following a brief **Introduction (PART 1)** to the particular features of adolescence and to the opportunities it provides, the three specific objectives of the document are dealt with as follows:

- **PART 2** – to identify the key nutritional problems that affect adolescents, the main risk factors, and their interaction with other health problems and life events
- **PART 3** – to identify and discuss existing recommendations, strategies and programmes on the prevention and control of these conditions
- **PART 4** – to propose a number of more specific actions for the health sector to address the nutrition-related needs of adolescents in the light of scientific evidence and lessons learned, while insisting on the importance of intersectoral approaches to nutrition in consideration of the multifactorial etiology of nutrition problems.

The focus throughout this document is on adolescents in developing countries, and this means addressing nutritional problems that are common to high, middle, and low-income groups, as well as those that are spreading throughout the world as a result of globalization. Although much of the research into the various factors of nutritional risk in adolescents has been carried out in high-income countries, many of the findings are also of relevance to middle and low-income settings.

Nevertheless, because of the very wide differences which exist between (and even within) all countries, the generalizing of problems or solutions is often meaningless. Although developed and developing country categories are used for the sake of simplicity, this dichotomy is becoming more and more irrelevant with respect to nutritional problems or other issues. The current document therefore deals where possible with adolescent nutritional issues in the context of the relevant setting.

Public health nutrition is given more emphasis than clinical nutrition since promotion and prevention are deemed more critical to adolescent nutritional health than individual case management, and because the recommendations are primarily intended for health-care providers and not for clinical nutritionists or dietitians. This paper does not therefore discuss in detail the nutritional requirements and dietary allowances of adolescents, nor does it delve into specific clinical conditions requiring therapeutic diets. It is felt that these aspects are beyond the scope of the present work. Furthermore, as it is becoming increasingly difficult to exhaustively cover all nutritional disorders, deficiencies, and risks in a single work, consideration has been focused upon a number of higher priority areas.

Adolescents are tomorrow's adult population, and their health and well-being are crucial. Yet, interest in the health of adolescents is relatively recent, and a focus on nutrition is even more recent, with the exception of adolescent pregnancy. This discussion paper intends to make evidence-based recommendations to help improve the contribution made by health-care providers to the nutritional health of adolescents, particularly in developing countries.

1

INTRODUCTION

Adolescents are tomorrow's adult population and their health and well-being are crucial. Yet, interest in adolescents' health is relatively recent and a focus on nutrition is even more recent, with the exception of adolescent pregnancy. This discussion paper intends to make evidence-based recommendations directed at the health sector to improve the contribution of health-care providers to nutritional health of adolescents, particularly in developing countries.

1.1 Adolescents: Who are they?

The term youth encompasses ages 10 to 24 years, while the term adolescents as defined by WHO (1986a) includes persons aged 10-19. Adolescents are sometimes designated as 'children', for instance, in the UN Convention on the Rights of the Child of 1989, which applies to all individuals below 18 years of age. The period of gradual transition from childhood to adulthood that normally begins with the onset of signs of puberty, is characterized by important psychological and social changes, not only physiological change. It is difficult to define in universal terms for there are important cultural differences. Depending on societies, the transition may be quick and the very notion of adolescence does not really exist, for instance where girls marry early and do not go to school. On the other hand, the transition of adolescence may extend over several years where young people remain in school and marry late, like in developed countries and increasingly in urban areas of developing countries (Paxman and Zuckerman, 1987). Adolescents are far from being a homogeneous group, in terms of development, maturity and lifestyle. Even for a given place and age, there is a great deal of diversity depending on personal and environmental factors. Adolescence may be divided into three developmental stages based on physical, psychological and social changes (WHO/UNICEF 1995):

- Early adolescence, 10/13-14/15 years;
- Mid adolescence, 14/15-17;
- Late adolescence, between 17-21, but variable.

Being in transition, adolescents may no longer benefit from the attention and care that usually go to children, but they may not get the protections associated with adulthood either.

Adolescents make up roughly 20% of the total world population. In developing countries, adolescents have an even higher demographic weight, for instance, roughly 26% in Salvador, compared to 14% in USA (Burt 1996). Similarly, in the Philippines, it is estimated that adolescents represent one quarter of the total population (Bouis et al, 1998). In 1995, there were 914 million adolescents living in the developing world, that is, 85% of the total (United Nations 1997). Their number is expected to reach 1.13 billion by the year 2025. With a lower fertility decline, Africa is expected to see its adolescent population grow much more rapidly than Asia and Latin America.

Adolescence is a period of rapid growth: up to 45% of skeletal growth takes place and 15 to 25% of adult height is achieved during adolescence (Rees and Christine, 1989). During the growth spurt of adolescence, up to 37% of total bone mass may be accumulated (Key and Key, 1994). Nutrition influences growth and development throughout infancy, childhood and adolescence; it is, however, during the period of adolescence that nutrient needs are the greatest (Lifshitz, Tarim and Smith, 1993).

Psychological and social aspects of adolescents' development are less often described in connection with adolescent health than their physical growth and maturation characteristics (Gillespie 1997). And yet

the former are as relevant to health and nutrition as the latter. Although the old stereotypes of 'generation gaps' and 'identity crises' need to be revisited, adolescence nonetheless operates a transition towards greater autonomy from parents and their values, and a progressively more central role of peers as role models, advisors, friends, and determinants of interests and values (Shepherd and Dennison, 1996; Mays and Orr, 1996). A now-dominant thinking is that most adolescents negotiate this transition without major disruptions or high risk behaviours, strengthening their own identity while maintaining their relationships with parents, and building new extra-familial relationships and skills (Offer 1987). Based on a review of international surveys of youth for the Lisbon Conference of 1998, Richard and Braungart¹ support this view, and contend that young people in general do not regard themselves as alienated, rebellious or antagonistic towards their families and adults. The majority of young people express positive views about themselves and their life situation, although a growing number do admit to some risky, experimental behaviours. Only a minority are involved in serious problems such as drug abuse, gangs and crime, and teenage pregnancy. They express the need for opportunities to develop a sense of independence, competence and participation in society. It is interesting that the 1996 study on 25,000 middle-class high-school students aged 15-18 years on five continents found them to be more similar than different in their values and concerns. According to this report¹, growing up in a developed or advanced nation today does not mean that youth problems are minimized. A gender gap seems to exist irrespective of the setting, in that boys express greater self-confidence, less vulnerability, and more happiness, pride and a subjective sense of well-being than girls. Conversely, adolescent girls have a higher self and body awareness than boys, and they tend to be less satisfied not only with their body, but also their appearance, their health, their personality (Cordonnier 1995). While young girls from western nations are more exposed to problems such as eating disorders, young women from developing countries are apparently at higher risk for suicide. A majority of adolescents think they are in good health, and they tend to feel invulnerable, with little motivation to protect their health "capital" for the future. This has a direct bearing on health promotion strategies.

1.2 Increasing focus on adolescent health and well-being

The sheer number and demographic weight of youth (or adolescents) gives them importance, even more so in developing countries, with a typically younger population, and as a result of the drop in under-five mortality. The future economic development of poorer countries rests in large part on the prospect of having increasing proportions of the future adults who are educated, healthy and economically productive. There is an important interaction between economic opportunity and attitudes of the youth as pertinently noted by Burt (1996). If there is little realistic hope of getting ahead economically, adolescents may have little incentive to invest in education and to stay away from health-threatening activities or behaviours. Conversely, without the prospect of a qualified, healthy and productive workforce, potential investors may be reluctant to commit to economic development. There are substantial costs to governments, societies and individuals for every failure of youth to reach adulthood alive, healthy, well educated and without dependants for whom they cannot care. When advocating investment in adolescents, it is important to consider specific cultural values, and to identify the most valued as well as the least wanted personal and societal outcomes.

The UNICEF Executive Director stated in a keynote address² that adolescents hold the key to the 21st century, insisting on the remarkable extent to which participating adolescents are a positive force for needed social change:

"There are one billion adolescents world-wide, and how effectively they cope with the perils of growing up will be a crucial element in whether humanity can surmount the challenge of the next Century. [...] Assuring young people's right to health and development is central to preventing immediate threats and a host of later problems that can threaten not only their lives, but their children's".

¹ Web site: www.un.org/events/youth98/backinfo/yreport.html, 18/04/99

² Web site: www.unicef.org/newsline/99pr6.htm, 16/04/99

For a number of years, the health of adolescents has not been a major concern and research has consequently been limited, as they are less susceptible to disease and suffer from fewer life-threatening conditions than children and elderly people. Indeed, adolescence is generally described as a period of relatively good health with low prevalence of infection and chronic disease (Senderowitz 1995). Mortality and morbidity trends among adolescents are quite similar in developing and developed countries (Blum 1991; Maddaleno and Silber, 1993). It is noteworthy that health services in developing countries focus on preschool-age children and pregnant women, with the consequence that health needs of adolescents may not be adequately met.

However, adolescents are very vulnerable to major social and economic changes, with resulting behaviours that threaten health, including: increased and unprotected sexual activity; substance use; and propensity to risk-taking. The costs and effects develop over a lifetime (Burt 1996). Reproductive health is understandably a major concern, with the human immunodeficiency virus (HIV), other sexually transmitted diseases (STD) and early pregnancy as main issues. One third of new STD cases, more than half the new HIV infections and one third of all births are among youth. While the five leading causes of death, illness and disability among young men are depression, traffic accidents, alcohol use, war and schizophrenia, in young women they are depression, obstructed labour, suicide, chlamydia and iron-deficiency anaemia³.

Since the International Youth Year of 1985 with its focus on participation, development and peace, world interest in adolescent issues in general and in the area of health in particular, has grown dramatically, as reflected in official policies and programmes. The United Nations General Assembly adopted in 1995 an international strategy: the World Programme of Action for Youth in the year 2000 and beyond³. Within the United Nations system, the Youth Unit has been set up as the focal point on matters relating to youth⁴. The World Programme recognizes that the situation of youths worldwide remains precarious and that, both in developed and developing countries, needs and aspirations of young people are still largely unmet. It is intended to address more effectively the problems of young people and to increase opportunities for their participation in society. Retaining the three themes of the International Youth Year, it identifies ten priority areas for action aimed at improving the situation and well-being of young people: education, employment, hunger and poverty, health, environment, drug abuse, juvenile delinquency, leisure time activities, girls and young women, and participation of youths in the life of society and in decision making, which cuts across the other issues⁵. Under health priorities, actions that are relevant for nutrition are not only nutrition education, but also preventive health programmes, the promotion of healthier lifestyles in cooperation with youth organizations, programmes to ensure universal and non-discriminatory access to primary health care, and school programmes of health knowledge and practices. Food security, a major determinant of nutritional health, is also addressed under the 'hunger and poverty' priority area.

The First World Conference of Ministers responsible for youth was held in Lisbon in August 1998 and the Lisbon Declaration on Youth, Policies and Programmes was adopted. It focuses on national youth policy development and implementation, enhanced participation of youth, action for education, development, peace, health and prevention of drug and substance abuse. The only health commitment directly addressing nutrition consists of improving access to malnutrition-prevention programmes as part of basic health care. The Braga Youth Action Plan was later adopted by the Third World Youth Forum of the United Nations held in Braga (Portugal), also in 1998. Recommendations are under youth policies and participation. Those that are of more direct relevance to health and nutrition are: that national youth policies, coupled with action plans, be cross-sectoral, comprehensive and formulated with long-term vision; and that integrated national youth health policy be formulated/reviewed and implemented, to address all major issues, including sexual and reproductive health, nutrition and hygiene, with the active participation of youth and youth-related organizations.

³ Web site: www.un.org/events/youth98/backinfo/yreport.htm, 18/04/99

⁴ Web site: www.un.org/esa/socdev/unyin, 18/04/99

⁵ Web site: see footnote 4

Regarding health more specifically, a common agenda was developed by WHO, UNFPA and UNICEF (WHO 1997a; 1999a) regarding actions for the health of adolescents, with the focus on improving knowledge, skills, access to counselling and health services, and safety and support of the environment (see Chapter 4). In 'Health21: The Health for all Policy Framework for the WHO European Region', as revised in 1998, one of the two main aims is to promote and protect people's health throughout their lives, the other one being to reduce the incidence of the main diseases and injuries, and to alleviate the suffering they cause. Health as a fundamental human right, equity in health and solidarity in action, and participation and accountability for continued health development are the basic values (Health21 1998). PAHO has a Program of Adolescent Health (Division of Health Protection and Promotion) which seeks to promote the health and development of adolescents and youth between the ages of 10 and 24 in the Region⁶, and which encompasses policy and advocacy, networking, evaluation of services and operational research.

Blum (1998) has identified the key roles of the health sector for adolescent health in the USA, recognizing a more prominent role for public health than for personal health care-strategies and noting the relative scarcity of prevention programmes.

It is noteworthy that in spite of a growing concern for adolescent health worldwide, adolescence has not been considered a high priority lifecycle stage for nutrition needs and intervention, with the exception of adolescent pregnancy. In the USA, however, nutrition was already outlined in 1990 as one of the key intervention areas in the 'Healthier Youth by the Year 2000 Project' of the American Medical Association. It should be recalled that in the UN Convention on the Rights of the Child, which also applies to adolescents the need to "*combat disease and malnutrition [...] through the provision of nutritious foods*" in order to fulfil the right to the highest attainable standard of health is explicit in article 24.

1.3 Objectives and content of the paper

Based on a literature search pertaining to developed and developing countries, the purpose of this discussion paper is to lay down the basis for WHO's recommendations on the prevention of nutritional disorders in adolescents and on their early detection/diagnosis and appropriate management. The specific objectives are:

- 1) to identify the key nutritional problems that affect adolescents, the main risk factors and their interaction with other health problems and life events;
- 2) to identify and discuss existing recommendations, strategies and programmes on prevention and control of these conditions; and
- 3) to propose additional recommendations when deemed relevant.

The focus is on adolescents of developing countries, which means also addressing nutritional problems that are common to high-, middle-, and low-income groups, as well as those that are spreading throughout the world as a result of globalization. Much research on various factors of nutritional risk in adolescents has been carried out in high-income countries, with many findings also of relevance to middle- and low-income ones. Therefore, the discussion paper deals with adolescent nutritional issues and programmes within their own setting. An important caveat is that because of very wide differences that may exist between and even within countries, generalizing problems or solutions is irrelevant, and the paper may be perceived as being over-simplistic in this regard because of the need to synthesize. Although developed and developing country categories are used for the sake of simplicity, it is reaffirmed here that this distinction is becoming more and more irrelevant with respect to nutritional problems or other issues.

⁶ Web site: www.paho.org/hpp/hppabout.htm, 16/04/99

Public health nutrition is given more emphasis than clinical nutrition since promotion and prevention are deemed more critical to adolescent nutritional health than individual case management and because the recommendations are primarily intended for health-care providers and not for clinical nutritionists or dietitians.

This paper does not discuss in detail nutritional requirements and dietary allowances of adolescents, nor does it delve into specific clinical conditions requiring therapeutic diets. It is felt that these aspects are beyond the scope of the present study. Furthermore, it was impossible to cover in this already broad study all nutritional disorders, deficiencies and risks in an exhaustive manner, and therefore only those that appear of higher priority are considered.

Following a presentation of nutritional opportunities, problems and risk factors in adolescence, general strategies and approaches are reviewed. More specific actions for the health sector to address nutrition-related needs of adolescents are then discussed in the light of scientific evidence and lessons learned, while insisting on the importance of intersectoral approaches to nutrition in consideration of the multifactorial aetiology of nutrition problems.

ADOLESCENCE PROVIDES A WINDOW OF OPPORTUNITY FOR NUTRITION

A transitional period between childhood and adulthood, adolescence provides an opportunity to prepare for a healthy productive and reproductive life, and to prevent the onset of nutrition-related chronic diseases in adult life, while addressing adolescence-specific nutrition issues and possibly also correcting some nutritional problems originating in the past.

2.1 Adolescence is a timely period for the adoption and consolidation of sound dietary habits

Adolescents are usually open to new ideas; they show curiosity and interest. Many habits acquired during adolescence will last a lifetime. Furthermore, with increasing age, adolescents' personal choices and preferences gain priority over eating habits acquired in the family, and they have progressively more control over what they eat, when and where (Thomas 1991; Shepherd and Dennison, 1996; Spear 1996). One expression of adolescents' search to establish themselves as autonomous members of society is through a change in eating habits. For these reasons, adolescents are an ideal target for nutrition education. In younger children, parents are in charge and need to be influenced. In adults, it may be more difficult to modify well-established patterns. Furthermore, adolescents may not only adopt healthy eating patterns and lifestyles for themselves, but also influence their peers, family and other community members.

Changes in lifestyle, including food habits, are often more obvious among urban adolescents, (Ahmed et al, 1998), as they are typically the 'early adopters' owing, among other things to their attraction for novelty and high exposure to commercial marketing in cities. Indeed, looking into adolescents' living and eating patterns may give an idea of the changes taking place in a society. They may act as role models for others in the community, in particular if they are from higher socioeconomic status groups. In this sense, the patterns seen in urban well-off adolescents anticipate the patterns of the future. Since these privileged youth are a reference group for other adolescents, they should also be targeted by health and nutrition promotion activities.

2.2 Improving adolescents' nutrition behaviours is an investment in adult health

Adolescents are in the process of establishing responsibility for their own health-related behaviours, including diet. It is therefore an appropriate time for health promotion programmes based on documented relationships between behaviour in this age group, obesity, cardiovascular and other chronic disease risk factors (see Chapter 3). Adolescents can and should take responsibility for their nutrition and the long-term repercussions on health. This may be quite a challenge, considering that adolescents tend to be little concerned with the future (Greene 1986), and long-term consequences of their present behaviours (Cordonnier 1995), but relevant strategies exist, based on an appropriate knowledge of personal and environmental determinants of food choice in this age group.

Nutrition is only one aspect of health behaviours and the development of these in relation with chronic disease is better conceptualized in a 'chain of risk' framework (Kuh et al, 1997). Over the life course, there may be an accumulation of biological and social risk. For instance, poor foetal nutrition (Barker et al, 1990; Barker 1996), in combination with inadequate or adverse influence of parents, peers and the educational experience in childhood and adolescence, sets the stage for chronic disease in adult life, with additional risk coming from cultural influences and lifestyles. In other words, beyond biological

programming, social patterning effects have to be considered. Adolescence may be a particularly relevant time for social patterning influences.

At least in certain population groups, another long-term benefit of improved nutrition in adolescence, particularly in girls, is the reduced risk of osteoporosis in older age. Calcium intake and bone deposition in adolescence are key factors of bone mineral mass later on in life, along with other determinants (see Chapter 3).

Influencing nutrition-related behaviours of adolescents implies that they have some choice and, therefore, that they have access to the required food resources. This may not be so as adolescents generally have less resources than adults, while being more on their own than younger children. This is why interventions to enhance economic and food security of adolescents and more generally of households may be required in order for nutrition intervention to have sustainable impact. Conversely, improved health and nutrition may positively affect productivity and, therefore, long-term economic and food security (Delisle 1998a).

2.3 There is potential for correcting nutritional inadequacies and perhaps even for catch-up growth

Adolescence is commonly regarded as a relatively healthy period of the life cycle. Indeed, adolescents are possibly less vulnerable to infection than they were at a younger age. This may contribute to their being somewhat neglected, but also it may mean that there is at adolescence less interference with adequate physiological utilization of food nutrients.

Once final height is attained, stunting becomes a permanent consequence of past malnutrition rather than being a sign of present malnutrition. Growth retardation is common in poorer countries, and it occurs primarily during the first three years of life. The growth spurt of adolescence has been seen as a period of potential interest for catching up growth deficit of childhood. If there is indeed catch-up growth in height, adolescence can provide a final chance for intervention to promote additional growth, with potential benefit in terms of physical work capacity and for girls, of diminished obstetric risk (see also Chapter 3). However, evidence confirming catch-up growth during adolescence is still limited, and mostly indirect. Prolongation of the growth period due to delayed maturation associated with malnutrition can make up for some of the earlier growth retardation, in other words, there is some degree of spontaneous catch-up (Golden 1994). It is suggested, however, that total reversal to affluent societies' levels of final height would probably require cross-generational catch-up. A review of adopted children's studies suggests that catch-up growth through accelerated growth rates can be quite pronounced, but that it is not complete, and that it would be minimal in populations which continue to reside in the same place (Martorell, Kettel Khan and Schroeder, 1994). It is possible that nutritional interventions induce an earlier and accelerated growth spurt, but it is not sure, based on available evidence, that it will affect final attained adult height, since it may then accelerate maturation, with a shortened growth period as a result. Remedial action in adolescence would be considered as coming late compared to that undertaken in infancy, but it may still be relevant, if shown to be effective in increasing lean body mass. However, catch-up growth intervention in adolescence will likely not improve other consequences of early growth retardation, in particular learning impairment (Martorell, Kettel Khan and Schroeder, *ibid.*). Furthermore, in adolescents who were born small because of intrauterine growth retardation, nutritional intervention for catch-up growth may result in gain in fat rather than in height (Léger and Czernichow, 1999), as such individuals appear more prone to becoming obese.

Studies undertaken as part of the adolescent research programme of the International Center for Research in Women (ICRW) contributed to knowledge about the extent of catch-up growth in height during adolescence, in the absence of or with food supplementation (Kurz and Johnson-Welch, 1994). In the Philippines, it was found that over an eight-year period, adolescents aged 11-20 years from lower income households had completely caught up with those in the higher group, without supplementation. Findings from the Mexico study suggest partial spontaneous catch-up growth during adolescence. Children who were supplemented from the age of three months up to 10 years were still taller at age 18 than the non-

supplemented group, but the difference between groups had minimized. In contrast, the Guatemalan longitudinal study found that the gaps in height among children at age five remained the same at age 18 (Rivera et al, 1995). In the metabolic study, also in Guatemala, it was found that levels of plasma insulin-like growth factor were somewhat higher in adolescents who had been receiving a supplement of 600 kilocalories per day for a sufficient time. However, the significance of changes in growth hormone levels in the short term for changes in stature over the long term is not known. In India (West Bengal), it was found that even within the same SES group, early menarche girls were heavier and taller than the late menarche girls (Bharati and Bharati, 1998), which would suggest that even if a longer growth period allows for some catch-up, it does not fully compensate for the pre-existing deficit in stature. In a cross-sectional study on nutrition and diet of Chinese adolescents (Wang, Popkin and Zhai, 1998), it was found that stunting was less prevalent in 1993 than two years earlier (19% vs 23%), which suggests that some catch-up growth in stature could have occurred with improving environmental conditions, but this is very indirect evidence.

Linear growth may be limited by multiple simultaneous nutrient deficiencies in many populations, which could explain that interventions with specific individual nutrients (vg, vitamin A, iron, zinc) have given conflicting results (Allen, 1994). Overall quality of diets may be reflected in growth, as we observed in preschoolers (Tarini, Bakari and Delisle, 1999). Once the deficiency in one single nutrient is corrected with the supplement, another nutrient may become limiting and reduce the growth response, and so forth, so that more research is needed to ascertain whether multinutrient dietary improvement (or supplementation) can enhance linear growth at the time of peak velocity, that is, around age 10-11 years, without accelerating maturational age beyond chronological age (Allen and Uauy, 1994).

Young girls can continue to grow during pregnancy (that is, after the adolescent growth spurt), from 2 up to 16 cm, according to Harrison et al (1985) who conducted a study in 69 primigravidae in Nigeria, among whom 59 were under 16 years. It seems that growth was correlated with red blood cell volume, and there was a close association of growth in height with iron and folic acid supplementation. This provides some evidence of positive effect of micronutrients on linear growth of adolescents even past the growth spurt, and hence, on the potential relevance of nutrition intervention in this regard. Further studies on the impact of multi-micronutrient supplementation on the onset and magnitude of the adolescence growth spurt have been recommended (Brabin and Brabin, 1992); there is also a great need to study the effectiveness of controlled interventions improving the nutritional quality of diets.

If there is indeed a window of opportunity for catch-up growth in adolescence through nutritional intervention, it is likely quite narrow, but it may extend beyond the adolescent growth spurt. However, further evidence of positive impact on height without encouraging obesity needs to be documented. Improved nutrition may accelerate maturation in adolescence, but this may also result in greater obesity in adulthood, as observed in the Amsterdam growth study (Post and Kemper, 1993; van Lenthe, Kemper and van Michelen, 1996). Similarly, further research on statural growth effects of multiple micronutrient supplements in adolescence is awaited. Notwithstanding some potential for catch-up growth in adolescent years, stunting in adolescence is best prevented during foetal life or infancy, as shown in longitudinal studies (see under Section 3.2.2).

2.4 Nutrition intervention in adolescent girls may contribute to breaking the vicious cycle of intergenerational malnutrition, poverty and chronic disease

As emphasized by the Executive Director of UNICEF⁷, one major reason for focusing on adolescents is that this period of a child's life is a unique opportunity to break a range of vicious cycles of structural problems that are passed from one generation to the next, such as poverty, gender discrimination, violence, poor health and nutrition.

⁷ See footnote 2, Web site: www.unicef.org/newsline/99pr6.htm, 16/04/99

Preparing for the demands of childbearing and breastfeeding is timely in adolescent girls and, above all, preventing premature pregnancy and its associated risk for both mother and child. Early intervention is particularly critical in adolescent girls whose nutritional status is marginal to begin with, so that they enter their first pregnancy in a better nutritional state. Improving adolescent girls' nutrition has the following reproduction-related benefits (Gillespie 1997):

- increased pre-pregnancy weight and body stores of nutrients, thus contributing to improved future pregnancy and lactation outcome, while preserving the mother's nutritional status and well-being;
- improved iron status with reduced risk of anaemia in pregnancy, low birth weight, maternal morbidity and mortality, and with enhanced work productivity and perhaps linear growth;
- improved folate status, with reduced risk of neural tube defects in the newborn and megaloblastic anaemia in pregnancy.

Small girls are likely to become small women who are more likely to have small babies, particularly if at a young age (see Chapter 3). Improving adolescent girls' nutrition and delaying their first pregnancy may be a promising intervention point to break this intergenerational cycle of malnutrition (ACC/SCN 1992b; UNICEF 1998). In Guatemala for example, maternal height, which is considered a proxy for both genetic and environmental influences, was a significant determinant of child size at 3 years, and even at adolescence when controlling for size at 3 years. This again underlines the intergenerational pattern of malnutrition (Kurz and Johnson-Welch, 1994).

There is growing evidence that foetal (and early infancy) malnutrition may be involved as a risk factor for chronic diseases in later life, in particular coronary heart disease, type-2 diabetes, and metabolic disease (Barker 1994). Thus, improving adolescent girls' nutrition before pregnancy (and during, but it is a second choice) may also contribute to break the vicious cycle of malnutrition, poverty and chronic disease.

Improving adolescent girls' nutrition has benefits other than for reproduction. The well-being and long-term nutritional health of women are legitimate goals in themselves. Women are also the key to household food safety and nutrition (Quisumbing et al, 1998). Improving their nutritional status and enhancing their nutrition-related skills is therefore likely to have long-range benefits for themselves and their families.

2.5 Reaching households and communities through adolescents

Many adolescents are in school, which provides an effective and efficient opportunity for reaching large portions of the population beyond students themselves: school personnel, families, community members (WHO 1996a). In Ecuador, the school nutrition programme successfully relied on this strategy of school children as agents of change at the household level (Chauliac et al, 1996a). However, a large proportion of adolescents are likely to be out of school at an early age in many low-income countries, in which case other strategies of reaching adolescents in person are needed, beyond impersonal communication through the media.

The peer approach to health education, for example, which is widely used throughout Latin America because of its effectiveness, allows to reach not only peers of the adolescents involved, but also other youth in their environment. It may use as a entry point the school, or another community-based institution. Also, the participation of youth in health education allows them to develop relations with adults outside their family and to acquire a sense of responsibility and belonging within a social group (Pommier et al, 1997).

As noted for Brazil (Doyle and Feldman, 1997), young people acquire work and family responsibilities at an earlier age in poorer countries than their European or American counterparts and, therefore, the family unit may be reached through this group.

ADOLESCENCE IS A PERIOD OF NUTRITIONAL VULNERABILITY

Adolescence is also challenging for nutrition, even if nutritional vulnerability may not be as great as in infancy and childhood. Adolescents are exposed to undernutrition, micronutrient malnutrition as well as obesity. Their lifestyle and eating behaviours, along with underlying psychosocial factors, are particularly important threats to adequate nutrition.

It may be said that adolescents are a nutritionally vulnerable group for a number of specific reasons, including their high requirements for growth, their eating patterns and lifestyles, their risk-taking behaviours and their susceptibility to environmental influences. Inadequate nutrition in adolescence can potentially retard growth and sexual maturation, although these are likely consequences of chronic malnutrition in early infancy and childhood. It can affect adolescents' current health and put them at high risk of chronic disease as well, particularly if combined with other adverse lifestyle patterns, even if the detrimental effects may take long to show. Compounded with growth, adolescent pregnancy exposes both mother and child to adverse health and socioeconomic consequences, particularly if the mother is stunted or undernourished. Hard physical work, as commonly observed in low-income countries, may impose additional physiological stress and nutritional requirements in adolescence. In certain cultures, from infancy onwards including adolescence, girls are at particularly high risk because of gender discrimination. In several countries of Asia, for instance, poorer nutritional status of women becomes apparent during adolescence, with a delay in maturation (Waslien and Stewart, 1994).

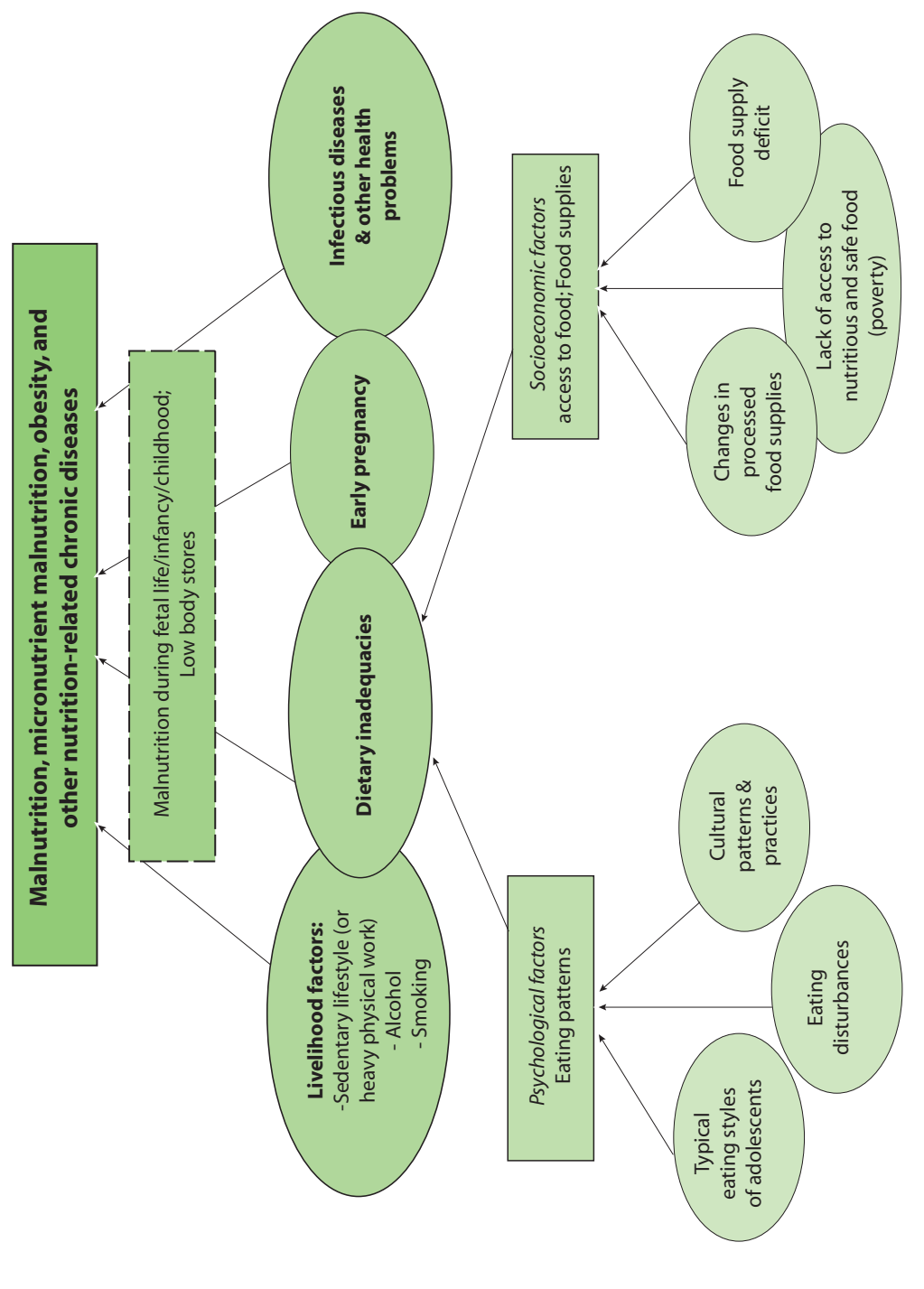
Even in countries like the USA and Canada, adolescents are considered as a nutritionally vulnerable subgroup because of their eating behaviours (Forthing 1991; Perry-Hunnicutt and Newman, 1993). Adolescents, particularly girls, are increasingly conscious of their body and this has a bearing on their diet. Teenage girls may excessively restrict their energy intake out of a desire to be thin, which is an additional factor of health risk. In addition to this, adolescent girls as a group may be at risk for inadequate intake of iron and calcium (Health Canada 1999). Athletics may also increase physiologic stress in adolescents and therefore increase nutritional risk (Lifshitz, Tarim and Smith, 1993).

The principal nutrition problems facing adolescents and their consequences will be reviewed, followed by the main factors of nutritional risk. A conceptual framework illustrating the problems and their determinants is first proposed as an analytical model for the study of nutrition-related issues in adolescence worldwide.

3.1 Conceptual framework for the analysis of nutritional problems in adolescence

The conceptual framework shown in Figure 1 illustrates the major nutritional issues in adolescence, whether nutritional problems as such or threats, along with underlying factors. This model, which is loosely adapted from UNICEF (1990), is deemed relevant for adolescents irrespective of geographic area or income level, although the magnitude of problems and priority issues may differ from one country to another, and even within countries. With the epidemiological and nutritional transition, coupled with globalization of economies, nutritional problems of industrialized countries become increasingly prevalent in low- and middle-income countries, notably obesity. Obesity, diabetes and hypertension are present in wealthy, middle-income and poor groups. It is recognized that the extremes of overnutrition and undernutrition are oftentimes concurrent problems in adolescent populations (Anderson 1991). Deficiencies can be found in poor societies because of poverty and in better-off groups

Figure 1: A conceptual framework of nutritional problems and casual factors in adolescence



because of poor eating patterns. Undernutrition, specific micronutrient deficiencies, obesity and other markers of chronic disease are grouped as problems in the upper portion of the model. The same determinants are at play anywhere: dietary inadequacies as the primary underlying cause, frequently coupled with lifestyle factors and health conditions that further compromise nutritional status. Infection as a factor of malnutrition may be relatively less important in adolescents than in under-five children (although adolescents are highly exposed to HIV), while lifestyle factors become more critical. Early pregnancy is a major risk factor in adolescence anywhere. Past malnutrition, or low body nutrient stores, are in the background; they may have consequences during adolescence or further increase chronic disease risk later on in adulthood. Stunting, for instance, originates in foetal life, in infancy or in childhood.

Determinants of dietary inadequacies are many, and they have been grouped under psycho-social and socioeconomic factors, while recognizing that they are intertwined. These factors are detailed in the Figure 1 and in the text as they are regarded as major threats to adequate nutrition in adolescence, along with lifestyles.

Based on our review and other documents dealing with nutrition in adolescence (Gillespie 1997; Chungong 1998; Treffers 1998), the following are seen as the main nutritional issues of adolescents in low- and middle-income countries:

- undernutrition and associated deficiencies, often originating earlier in life;
- iron deficiency anaemia and other micronutrient deficiencies;
- obesity and associated cardiovascular disease risk markers;
- early pregnancy;
- inadequate or unhealthy diets and lifestyles.

While the first three are nutritional problems as such, the last two are risk factors that may result in nutritional problems. No ranking is attempted because while they are all critical, there are important variations in their relative magnitude, and hence in priority issues, depending on the population group considered.

There are other nutrition-related problems that need not be overlooked, dental health problems for instance. There are also pathological conditions that alter nutritional status or require specific nutritional management, in particular diabetes and HIV/AIDS; these are discussed in Chapter 4 under 'Case management of nutritional problems'.

3.2 Nutritional problems in adolescence

Adolescents' nutritional problems may represent a heavy health burden, but estimations of disability-adjusted life years lost (DALYS) made by the World Bank (1993) mainly take account of nutritional deficiencies among pre-schoolers and pregnant women. Furthermore, the deleterious effects of deficiencies in adolescents, and of nutrition-related disorders such as obesity, are ignored in these figures, in the short and in the long term (calcium, for instance, with osteoporosis), possibly owing to as yet insufficient data on their contribution to morbidity and mortality.

Up to recently, little was known about nutrition of adolescents, particularly in low- and middle-income countries. In 1990, the IRCW/USAID Nutrition of Adolescent Girls Research Program was established to provide information on factors that affect, and are affected by, nutritional status of adolescents (including boys), in order to guide the formulation of policies and programmes. Eleven widely different research projects were supported in Latin America and the Caribbean, in Asia and in Africa. Most studies were cross-sectional, but two were longitudinal and one was a food supplementation trial. These studies made a major contribution to the present knowledge of nutrition in adolescence (Kurz and Johnson-Welch, 1994; Kurz 1996). Other than these, there is a dearth of data on adolescents' nutritional status in developing countries. This was underlined in the South-East Asia Region, and especially for non-school attending, non-pregnant adolescent girls aged 12 to 16 years, called the 'grey area' (WHO Regional Office for South-East Asia, 1997). Not only data but also programmes to improve the health situation of

adolescent girls and women in the region were deemed unsatisfactory. Appendix I provides a summary of existing data on malnutrition, micronutrient malnutrition and obesity in adolescents of developing countries.

The overall nutritional status is better assessed with anthropometry, in adolescence as well as at other stages of the life cycle. Anthropometry is the single most inexpensive, non-invasive and universally applicable method of assessing body composition, size and proportions (de Onis and Habicht, 1997). However, because of important changes in body composition during adolescence, and particularly during the puberty-related growth spurt which varies in its timing, assessment of obesity, or undernutrition, is more complex in adolescents than in adults or younger children. Much less is known and done on adolescent anthropometry than in younger age groups. It is possible that rapid changes in somatic growth in adolescence, problems of dealing with variations in maturation rate, and the difficulties involved in separating normal variations from those associated with health risk have been deterrents to developing a corpus of scientific knowledge linking adolescent anthropometry with determinants and outcomes. Nutritional status assessment in adolescence is an issue and it is further discussed under strategies and approaches in Chapter 4 (section 4.5) because of the practical implications.

3.2.1 Undernutrition, stunting and consequences in adolescence

3.2.1.1 Overview on malnutrition in adolescence

Overall nutrition status was shown to be very poor among adolescent girls of poor rural groups in India (Rajasthan). Chaturvedi et al (1996) reported that 79% suffered severe chronic energy deficiency (BMI <16), 74% from anaemia and 44% had signs of vitamin B complex deficiency. On the basis of national recommended dietary allowances, intakes were grossly inadequate both in terms of energy and protein. Similarly, in urban Bangladesh, Ahmed et al (1998) reported inadequate intakes in a high proportion of schoolgirls aged 10-16 years, although these girls may be considered more privileged than their non-school counterparts, whether urban or rural. Only 9% met the recommended daily allowance (RDA) for energy and 17% for protein. Girls from less educated families (particularly mothers) were more likely to be thin and short for their age and to have diets of poorer nutritional quality.

Based on available information, a general profile of adolescent girls' nutritional status was sketched in the South-East Asia Region (WHO Regional Office for South-East Asia, 1997):

“They are undernourished, indicating a chronic energy deficiency. Most often, the BMI of adolescent girls of 13 and above is below 18.5. The girls are usually physically stunted, a manifestation of chronic protein energy malnutrition and have a narrow pelvis indicating that the full growth of the pelvis has yet to take place.[...] Iron deficiency anaemia is the most glaring nutritional deficiency,[...] with no less than 25-40% of adolescent girls as victims of moderate and sometimes severe anaemia. [...] In all countries of the region, at least 40-50% of adolescent pregnant girls are anaemic”.

Undernutrition, defined as BMI <5th percentile of NCHS reference values (WHO 1995a), was highly prevalent in three of the 11 studies of ICRW: 53% in India, 36% in Nepal and 23% in Benin⁸. Even where prevalence was high, BMI tended to improve with age. However, this may simply reflect a pattern of later maturation. In most studies allowing comparisons of boys and girls, there was twice as much undernutrition in boys as in girls. One possibility is a differential maturation in boys and girls; another one, which warrants further investigation, is connected with the high rates of anaemia, which could affect body weight of boys more than girls because the former put on more muscle than the latter (see Section 3.2.2).

⁸ According to this empirical and statistical definition, the rate of ‘undernutrition’ in the reference population of American adolescents is accepted to be of the order of 5%

In Nigeria, a study among adolescent girls (Brabin et al, 1997) showed that undernutrition was more widespread in rural than in urban areas: 10% of rural and 5% of urban girls were stunted (£ 2nd percentile, British reference values of 1990), and 16% vs 8% could be considered thin (£ 9th percentile BMI). However, there may be wide infra-urban variations according to socioeconomic status (SES), which is not known. It is not known either, in the absence of longitudinal data, to what extent early adolescent stunting might be compensated for in late adolescence. There was no important problem with overweight in rural or urban groups.

In emergency situations, particularly when crisis situations persist for long periods of time, adolescents may be affected by severe undernutrition, much like younger children, although in many cases therapeutic nutrition programmes are not open to them. Using the 5th percentile of NCHS/WHO BMI reference values as an indicator of acute undernutrition, a report on Somali and Sudanese refugees in Kenya indicated that roughly 60% of 10-19 year-old people were undernourished⁹. However, the authors themselves suggest that this cut-off may overestimate the real extent of severe malnutrition in this age group, based on ancillary data on morbidity and mortality rates. Severely undernourished adolescents may be at lower risk of death or opportunistic infection than pre-school age children, and yet data from refugee camps in Africa showed that 48% up to 73% of excess deaths were among people above 5 years of age (Davis 1996). Adolescent refugees' capacity to do physical work may be seriously curtailed by severe undernutrition, which further compromises their own and their family's welfare because of resulting limitations in food production and other income-generating physical activities. Preliminary results of a recent survey on a random sample of adolescent Nepali refugees from Bhutan (Woodruff et al, 1999) show a lower rate of undernutrition than in Kenya, with 34% of adolescents having a BMI lower than the 5th centile of WHO reference population for sex and corrected age for delayed puberty. Angular stomatitis suggestive of riboflavin deficiency was observed in 29% of the adolescents, a deficiency which is now seldom observed in stable populations. Overall, 26% were anaemic. Rates of low BMI were similar in adolescents and in adults. However, in the absence of comparable data from the Nepali population, and since the BMI cut-offs may not apply to all adolescent populations, it is not possible to conclude that undernutrition in these refugees represents a public health problem.

Stunting is commonly observed among adolescents in undernourished populations. In the ICRW studies, stunting (height <5th percentile of NCHS/WHO reference data) was highly prevalent in nine of the 11 studies, ranging from 27% in urban Guatemala to 65% in rural Philippines (Kurz and Johnson-Welch, 1994). Short stature in adolescence is mainly caused by infection and inadequate dietary intake during the pre-school years, and foetal malnutrition may also be a factor. However, ethnic differences may be present and would have to be taken into account, more so in adolescence than earlier on¹⁰. In both African studies, males were worse off than girls, whereas the reverse was true in India. A possible explanation for the former was that in Africa, boys are encouraged to be autonomous at a younger age than girls, meaning that they are more likely to be exposed to infection. The gender difference in India was tentatively explained by the deeply embedded sociocultural and economic practices that often discriminate against females of all ages. It may also be that growth is delayed in adolescents, more so in boys than in girls, perhaps owing to transient anaemia (see Section 3.2.2).

Longitudinal studies conducted in Guatemala provide strong evidence for the important role of early childhood nutrition on anthropometric nutritional status of adolescents. These studies indicate that in this population, most of the growth deficit observed in adolescents and adults occurred during the first three years of life. The positive effects of energy and protein supplementation during the first three years of life indeed persisted at adolescence: height, weight and fat-free mass were still higher in the supplemented than non-supplemented individuals (Kurz and Johnson-Welch, 1994; Rivera et al, 1998).

⁹ Woodruff B, Bhatia R, NGONut Listserv Discussions, Feb. 5, 1999 (ngonut@abdn.ac.uk)

¹⁰ For instance, the studies of Leung and Lui in Hong Kong, which provide evidence of a stable systematic difference in stature between northern and southern Chinese. In Hong Kong, the secular trends of growth in height have flattened, and it is questionable that high rates of 'stunting' as defined by reference to NCHS reference data should be interpreted as a residual effect of former nutritional compromise, in this generation or the previous one (S Oppenheimer, on Ngonut network, ngonut@abdn.ac.uk, 22/04/99)

3.2.1.2 *Malnutrition delays physical growth and maturation*

There are wide variations among populations in median age at menarche, which ranges from 12.5 years in high income countries, to 15 and above in poorer countries (Becker 1993). Several factors are likely involved in this variance, and nutritional status is considered to be a major one (Bongaarts and Cohen, 1998). Evidence is of four types. First, a relationship between nutritional intakes and the timing of puberty onset has been observed in many populations, with better nourished girls reaching menarche earlier than undernourished girls. Secondly, anthropometric indices of growth and the timing of puberty onset are correlated in humans and many other species alike. Third, a gradual reduction in age of menarche has been observed with progressive improvements in socioeconomic conditions and nutrition over the last 200 years in western societies. And conversely, studies across populations show a negative correlation between SES and the age of menarche. However, poor health status and psychological stress are correlates of poor nutrition that may also delay the onset of menarche in lower SES groups. It is suggested that the mechanism by which undernutrition delays or suppresses activity of the reproductive axis in adolescents or adult women, is through decreased available energy, rather than body composition changes (Cameron 1996), as suggested by rapid reversal of exercise-induced reproductive dysfunction by increasing food intake, without long-term negative effect on reproductive capacity.

Among girls, the “growth spurt” normally takes place between 12 and 18 months before the onset of menarche, which occurs between the ages of 10 and 14. Then growth in stature continues for up to 7 years. Growth of pelvic bones continues for another 2-3 years after height growth has stopped (Moerman 1982). Maximum bone mass is not achieved before 25 years (National Academy of Sciences 1997).

In undernourished populations, growth rate during adolescence is slower (Eveleth and Tanner, 1990). Using maximum growth spurt or menarche as an indicator, maturation may be delayed in malnourished girls by an average of two years (Dreizen, Spirakis and Stone, 1967). Growth is delayed, when it is not depressed. There are differences according to socioeconomic level, and there may also be ethnic differences that are not fully accounted for by environmental conditions. For instance, in Guatemala, median age at menarche is significantly higher in Indian adolescents living in rural areas than in non-Indians; lowest age is among the urban, non-Indian Guatemalans. Age at menarche is also inversely associated with weight, arm circumference, height, and BMI (Delgado and Hurtado, 1990). In Nigeria, it was found that schoolgirls from the upper socioeconomic class reached menarche 11 months earlier than the lower socioeconomic counterparts (Abioye-Kuteyi et al, 1997). In India, it was observed that peak weight and height velocities were delayed by 18 months for children who were stunted at 10 years of age (Kanade 1994). Spontaneous or intervention-related catch-up growth during adolescence is discussed in Chapter 2.

3.2.1.3 *Stunting and delayed maturation compound risk of adolescent pregnancy*

Short stature is oftentimes associated with small pelvises in women, and this is an important risk factor for obstructed labour. The risk rises sharply when the stature is below 1.45 m, which is the case of 16-18% of women in Asia, 11-15% of women in Latin America and 3% in Africa (ACC/SCN 1992a).

So maternal stunting is a factor of increased obstetric risk, and it can be attributed to chronic malnutrition, at least in part. In addition, delayed growth and maturation in girls as a result of malnutrition further increases the risks associated with adolescent pregnancy, as biological age lags behind chronological age (see under Section 3.3).

3.2.1.4 *Malnutrition reduces work capacity*

Adolescents' contribution to agricultural and domestic chores is critical in many populations and it is suspected that undernutrition (and stunting) might limit work capacity and endurance of both boys and girls. The relationship between nutritional status and productivity is complex, as discussed by Kennedy and Garcia (1994), and there have been very few specific studies on adolescents. What is nonetheless suggested by available data from various studies and countries is that BMI, fat free mass and height are associated with increased time devoted to work and with work capacity. Early malnutrition

would affect physical work capacity through an adverse effect on height, body mass and, more specifically, muscle mass. Height in particular has most often been shown to be associated with work output, productivity or income. Usually, when expressed per unit of height or body mass, differences in work capacity were no longer observed, but it is total work output that has practical implications for productive potential, and which may be affected by chronic (or current) malnutrition. However, increased time devoted to work and higher physical work performance are not easily evaluated when a high share is devoted to home production activities, which is more often the case among women than men, whether in adolescence or in adulthood.

A prospective study carried out in Guatemala provides new information on chronic effects of early nutrition on physical work capacity in adolescents (Haas et al, 1996). The study included an intervention phase of high-energy high-protein supplementation during prenatal life and pre-school years, and a follow-up phase of many years. In the 14-19 year-old cohort males, those having been exposed to early supplementation had a significantly higher oxygen uptake than control subjects at near-exertion levels ($\text{VO}_{2\text{max}}$), which provides a measure of physical work capacity. The supplementation effect was not significant in girls, which is attributed to the low levels of physical activity generally seen in girls in this society. The difference observed in males remained significant, although reduced, even after controlling for fat-free mass, which is at variance with previous studies. One suggested explanation, based on experimental data in animals, is that early malnutrition may affect the quality of muscle tissue in terms of fibre type, with an effect on the proportion of fast to low-twitch fibres. However, further research is required to elucidate this effect, as well as to assess better the relationship of physical work capacity with economic productivity. Micronutrient malnutrition, iron deficiency in particular, may also affect work capacity and has to be taken into account in such studies.

3.2.2 Iron deficiency anaemia and other widespread micronutrient deficiencies

3.2.2.1 Iron deficiency and anaemia

Anaemia, whether or not the primary cause is iron deficiency, is generally recognized as the main nutritional problem in adolescents. Of 39 studies reviewed by De Maeyer and Adiels-Tegman (1985) on the prevalence of anaemia in adolescents, 32 were carried out in developing countries. Estimated prevalence was 27% in developing countries, and 6% in industrialized countries. Results showed that in Africa, Oceania, Latin America and the Caribbean, the prevalence was higher among adolescent boys than girls. In the ICRW/USAID studies (Kurz and Johnson-Welch, 1994), anaemia in adolescents was quite high in Nepal (42%), India (55%) one of the two Guatemalan studies (48%) and Cameroon (33%). It was lower in Ecuador (17%) and Jamaica (16%). In rural Guatemala, it was low: 5%. These wide variations are not entirely understood, and illustrate how different the problems may be among countries. The prevalence was as high in boys as in girls, and it was higher among boys in one study (Ecuador). Because of muscle mass development, boys have high iron requirements, as mentioned earlier, although girls are usually expected to have higher anaemia rates due to onset of menarche. However, as the growth of adolescents slows down, boys' iron status improves. It is not known whether transient anaemia among adolescent boys has functional consequences. Hence, the long-term benefit of intervention in this group is not known. In growing girls, there is a paucity of data on iron requirements, and the consequences of iron deficiency.

In Cameroon, prior to a school-based health education programme among adolescents, needs were assessed through KAP (knowledge-attitudes-practices) studies and focus groups with adolescents, literature reviews and workshops (Chendi 1998). Iron deficiency and anaemia were identified as one of the major health and social problems affecting the youth.

As reported in a study of iron and zinc status among adolescent girls consuming vegetarian or omnivorous diets in Canada, suboptimal iron and zinc status was the result of intake of poorly available sources of iron and zinc in all dietary groups (Donovan and Gibson, 1995). Similarly, iron deficiency and anaemia are reportedly common in British adolescents, especially in girls, with a prevalence of up to 22% hemoglobin (Hb) levels below 120g/l, and 4-43% of low ferritin levels [<10 or 12mg] depending on the

region, ethnic origin, SES, intake, and sampling and analytical methods (Nelson 1996). Low iron intakes alone do not fully account for the high prevalence of anaemia. Other factors such as low vitamin C intakes and some aspects of lifestyle such as dieting for weight loss or untutored adoption of vegetarian diets, were associated with increased risk.

Iron requirements of adolescent girls may be further increased because of infections such as malaria, schistosomiasis, and hookworm infection (Brabin and Brabin, 1992). Tuberculosis and HIV infection are other etiological factors of iron deficiency (van den Broek and Letsky, 1998), and it is known that sexually active adolescents are at increased risk of HIV infection. In Nigeria, Brabin et al (1997) found that adolescent girls who had low Hb (<10g/dl) were more likely to have a low BMI than those who had higher Hb levels, suggesting that overall malnutrition is associated with anaemia.

Heavy menstrual blood loss may be an important factor of iron deficiency anaemia, as observed in Nigerian girls, and it might also be related to vitamin A deficiency (Barr et al, 1998). A 12% menorrhagia rate was found among nulliparous, menstruating girls aged less than 20. Menorrhagia was suspected to be an important contributor to the high rate of anaemia (40%). In a population like this where contraception is desired and culturally acceptable, the authors suggest that contraceptive pills would be the treatment of choice for menorrhagia, while improving iron status.

The relationship of geophagy with iron status and anaemia is still obscure. In Kenya, this practice was reported by more than 70% of school children aged 10-18 years, and 56% of pregnant women reported eating soil regularly (Geissler et al, 1998a, 1998b). Whilst the soil is a potential source of iron, a negative association between iron status and geophagy was found. Either geophagous subjects are deficient to begin with, or soil components interfere with iron uptake or metabolism.

Iron deficiency and anaemia may be common among adolescent athletes, owing to chronic urinary and gastrointestinal blood loss and to intravascular hemolysis that are associated with strenuous exercise combined with endurance events (Raunklar and Sabio, 1992). It is not known whether heavy physical work which characterizes many poor population groups could contribute to iron deficiency and anaemia among adolescents.

The consequences of anaemia in terms of poorer pregnancy outcome are well known. In addition to a higher risk of low birth weight, prematurity, stillbirth, neonatal infection and maternal mortality, anaemia in pregnancy may be associated with a higher risk of hypertension and heart disease in the offspring of anaemic mothers (Barker et al, 1990). An inverse association between size at birth and systolic blood pressure in childhood and adult life has also been consistently observed in many studies (Law and Shiell, 1996).

Iron deficiency anaemia also reduces physical work capacity, as suggested by positive impact of iron supplementation on work productivity of women tea pickers in Indonesia (see Behrman 1992) and Chinese women working in factories (Li et al, 1994). Iron deficiency, even without anaemia, may represent a high loss of productivity in physically demanding work, and in less strenuous labour as well (Ross and Horton, 1998). For heavy manual labour, iron therapy in anaemic adults is estimated to result in a 17% increase in work productivity, and this is considered to be a conservative estimate based on existing evidence. To our knowledge, studies on work productivity in relation with iron status were not performed in adolescents, but there is no reason to believe that iron deficiency would not have similar adverse effects among them. Translated in economic terms, the overall productivity loss associated with iron deficiency, including cognitive deficits in children, is about US\$4 per capita (Ross and Horton, 1998). Iron deficiency has also been shown to reduce endurance among athletes (Raunklar and Sabio, 1992). There is evidence of short-term effects of anaemia on performance capacity and recovery from physical activity, as assessed by heart rate, in British adolescent girls from different ethnic backgrounds (Nelson, Bakaliou and Trivedi, 1994). If even mild anaemia affects physical activity, it may in the long term affect bone and heart health (Nelson 1996), since it may prevent a healthy pattern of physical activity from being established in adolescence. Risk of osteoporosis and bone fracture is inversely proportional to

exercise levels, and activity levels in adolescence may be reflected in activity levels at middle age. Similarly, physical activity is a protective factor in relation to heart disease.

Iron deficiency may alter cognitive function in children (Pollitt et al, 1985) and even in adolescents (Ballin et al, 1992) and the effects may be only partly reversible in severe and prolonged deficiency. Effects on cognition beyond childhood are less well documented and understood however, although improvements in cognitive tests following iron supplementation were reported among adolescents in south and south-east Asia, but not in the United Kingdom (Nelson 1996). In population groups with a high rate of anaemia, this nutritional problem may contribute to poor levels of school achievement, along with social and other environmental factors. In a study among adolescent schoolgirls (13-14 years of age) of low SES in Jamaica (Walker et al, 1994; 1996), anaemia was identified as the principal nutritional problem, affecting 16% of the girls. Height for age, hemoglobin level, and reported hunger episodes were significantly correlated with school achievement. Anaemia remained significant when controlling for social factors and school attendance, although social and behavioural factors may be more significant determinants of school performance in adolescence than in earlier years. For instance, it was found that having many household chores to do before going to school affected the girls' school attendance and, through this, their achievement.

The role of iron deficiency (and perhaps also folate) in depressing physical growth, as suggested in studies on supplemented pregnant adolescents, has been referred to earlier (see Chapter 2).

In the USA, the second National Health and Nutrition Examination Survey (NHANES II) results indicated that anaemia occurred in 5% of males aged 11-14 and approximately 2.5% of females aged 11-19 (Expert Scientific Working Group, 1985). For the higher prevalence in boys, which is also observed in developing countries, the only explanation proposed was poorer dietary habits.

Clinical data do not support the suggestion that iron deficiency protects against infection, or that correction of iron deficiency increases the severity of infectious disease (Chandra 1991), or the prevalence of malaria (Menendez et al, 1994).

Iron deficiency is related to vitamin A status. Many studies suggest a direct interaction between vitamin A status and the utilization of dietary and stored iron for hemoglobin formation (Bloem et al, 1989; Meija 1992; Ahmed et al, 1993). Among urban adolescent schoolgirls in Bangladesh, probably a more affluent segment of the population, the rate of anaemia was 22% based on $Hb < 120g/l$ (Ahmed et al, 1996). Other biochemical findings were indicative of iron deficiency anaemia. The girls with the lowest retinol level were found to have lower values for Hb and other biochemical indices including serum iron and transferrin saturation, even after adjustments were made for potentially confounding socio-demographic factors. This again suggests that vitamin A deficiency may have contributed to the aetiology of iron deficiency anaemia. Thus, marginal vitamin A status may compromise iron metabolism. This is of particular concern in adolescent pregnancy. Furthermore, some studies suggest that menstrual irregularities may be more frequent in women with low vitamin A stores or serum retinol (Barr et al, 1998). For Brabin and Brabin (1992), the associations of both vitamin A and iron with menstrual blood loss suggest the need for controlled studies on the range of blood loss in chronically malnourished adolescent girls. Similarly, they see the need for baseline data on vitamin A deficiency, anaemia and menstrual disorders in young women, in order to assess the relative importance of nutritional status for reproductive health in developed and developing countries.

In Malawi, it was reported that a high proportion of rural non-pregnant adolescent girls were anaemic (only 11% had Hb equal or greater than 12 g/dl) and deficient in vitamin A (27% had serum retinol < 0.7 mmol/L and 40% had low vitamin A stores according to the modified relative dose response test (MRDR) and vitamin E, although the precise significance of the latter is as yet unclear (Fazio-Tirrozzo et al, 1998). Younger girls were more likely to have a marginal vitamin A status than older ones. Among the primiparous adolescents, 74% had serum retinol < 0.7 mmol/L. The authors advocate vitamin A supplementation among adolescents, or else extended supplementation in schools up to 12 years, but this would hardly be sustainable in Malawi since school attendance is so low.

3.2.2.2 Vitamin A deficiency

Although the risk of vitamin A deficiency tends to decline with age, it is now apparent that it often extends in adolescence and early adulthood (Henning et al, 1991), especially among women (Bloem et al, 1995). Evidence of high deficiency rates in adolescents in Bangladesh and Malawi was just described. In adolescent female factory workers in Bangladesh (Ahmed et al, 1997), it was found that 56.2% had low serum retinol (<1.05 mmol) and 14.2% were deficient (serum retinol <0.7 mmol/l). After adjusting for potential confounders, it was found that serum retinol was significantly higher in girls who consumed milk and dark green leafy vegetables more frequently. Here again, serum retinol and Hb were correlated. Nearly half (44%) were anaemic, which is twice as high as in upper-level-school adolescent girls (Ahmed et al, 1996). These girls were not wasted, however.

In Cameroon, the study on adolescents (Kurz and Som, 1998) revealed that vitamin A intakes were extremely low. This again suggests that vitamin A deficiency in adolescence may be of particular concern.

Very few studies have investigated the relationship of specific nutrients with delayed and catch-up growth in adolescents. As noted above, iron, and possibly folate, may be involved in adolescent growth (Harrison et al, 1985). Based on existing data, Brabin and Brabin (1992) hypothesize that iron and vitamin A requirements are increased for growth in adolescence and that deficiencies may be a consequence of growth on marginal diets among adolescent girls. The relationship of serum retinol binding protein and retinol with puberty level suggests an important role of vitamin A in sexual maturation (Herbeth et al, 1991).

3.2.2.3 Iodine deficiency disorders

Iodine deficiency disorders were widely prevalent in most populations until corrective measures were taken. Neuromotor and cognitive impairments of variable degrees are the most important consequences of iodine deficiency (Stanbury 1998). Iodine deficiency is recognized as the most common cause of preventable mental retardation in the world. Cretinism is only the extreme end of the spectrum. In iodine-deficiency areas, a downward shift of IQs has been reported (Bleichrodt et al, 1989), as well as lower performance in school after controlling for confounding variables (Fierro-Benitez et al, 1986). In India, a study compared learning and motivation in male schoolchildren aged 9-15 years from severely iodine-deficient villages and from mildly iodine-deficient villages, after matching the groups for age, SES and formal education (Tiwari et al, 1996). The results suggested that children from severely deficient villages not only suffered neural impairment, but also lacked socio-psychological stimulation in the endemic sites, which explained learning disability, as well as low motivation to perform. Foetal and pre- and postnatal survival is markedly affected by iodine deficiency, as strongly suggested by a doubling of neonatal survival following correction of the deficiency in Chinese communities (De Long et al, 1997). Thus, iodine deficiency, because of its lasting effects on survival and intellectual achievements, is a major obstacle to social and economic development. Iodine deficiency affects all age groups, but goitre primarily affects people aged 15-45 years, in particular women, as shown for example in Côte d'Ivoire (Kouame et al, 1998). There are rare instances of endemic goitre in the absence of iodine deficiency, like in one province of South Africa (Jooste et al, 1999). This is not entirely explained, but high fluoride content of drinking water and dietary goitrogens may be involved.

Control of iodine deficiency is imperative, considering the dramatic repercussions on neonatal mortality and mental development, and it is well under way (see Chapter 4). Understandably, women of reproductive age are a priority target group for intervention. Iodine deficiency is assessed by goitre and urinary iodine levels among schoolchildren, as these are captive groups. Some adolescents are 'captured' in these surveys, but evaluation or surveillance data are not reported separately for this group.

3.2.2.4 Micronutrient deficiencies and bone disease

Calcium requirements for skeletal development appear to be even greater during adolescence than childhood or young adulthood (Matkovic and Ilich, 1993). Because maximum bone mass is acquired

during adolescence, calcium deposited during that period determines the risk of osteoporosis in adulthood. Adverse effects of calcium deficiency have also been observed at adolescence. For instance, it was reportedly associated with bone demineralization in lactating adolescents (Chan et al, 1987), and increasing calcium intake reversed the condition. Calcium deficiency apparently increases the risk of bone fracture even among adolescents, as observed among those not meeting 60% of dietary allowance for calcium (Chan et al, 1984). It was reported that milk consumption had an impact on bone and body composition in Caucasian pubertal girls (Chan, Hoffman and McMurray, 1995). However, the findings of this last study raised controversy (Kerstetter and Insogna 1995; Solomons 1996), with the small sample size recognized as a major weakness. Nevertheless, more significant increases in bone mass and density had been previously observed in a larger study group (Lloyd et al, 1993). In Hawaii, Novotny et al (1996) found that a higher consumption of milk during adolescence was among the significant determinants of a higher height of white women compared to Japanese women. Other factors were a higher age at menarche and higher birth weight, but ethnicity was also significant.

Does failure to achieve genetically programmed bone mass during teen years leave an irreversible deficit, or is catch-up possible in the 20s? It was believed that peak bone mass was reached by the late teen years (Bonjour et al, 1991). However, there is supportive evidence for continuing bone acquisition after the adolescent growth spurt, and calcium intake appears to make a difference, at least in Caucasians (Recker et al, 1992). The window for bone building may remain open for a few years after growth in height has stopped (Heany, 1998), but there may be wide disparities among populations.

Calcium deficiency is associated with high post-menopausal bone loss. Regular consumption of dairy products during adolescence was found to be related to lower levels of post-menopausal bone loss, as shown in a retrospective study of Caucasian American women aged 49-66 years old (Sandler et al, 1985). However, many other determinants are at play, and in a cross-sectional study of osteoporotic women in Mexico City, parity was a significant negative factor, while current exercise level and body mass index were positively related to bone mineral mass (Parra-Cabrera et al, 1996).

While adolescence is a time of high calcium requirements, surveys suggest that adolescent diets are often inadequate in calcium, at least in high income countries such as the USA (Morgan et al, 1985). Girls are apparently twice as likely as boys to be deficient, 85% vs 43% respectively (Key and Key, 1994). Although factors other than diet, in particular exercise, also contribute to calcium status, adequate calcium intake, with supplementation when needed, is recommended in adolescents in the USA. (Key and Key, *ibid*).

However, calcium nutriture in developing countries and in populations other than Caucasians is poorly understood, and it is not known whether osteoporosis may be modulated by calcium intake during childhood and adolescence. This is an area where research is urgently needed. Calcium-deficiency rickets (without vitamin D deficiency) has been reported in children in Africa (Thatcher, Ighogboja and Fischer, 1997) and in Bangladesh (Fischer et al, 1999), but the aetiology remains obscure. There are racial differences in the incidence of osteoporosis. While it was considered to be relatively unimportant in developing countries (Scrimgeour 1992), data indicate that it is an increasing problem among women in many Asian countries (Shatrugna 1998), and even in Africa (Aspray et al, 1996). There is a pressing need for research on calcium nutriture and osteoporosis in non-Caucasian populations.

Evidence from supplementation trials suggests that marginal zinc nutriture may also limit skeletal growth in some infants, children and adolescents (King 1996). In Guatemalan infants, zinc supplementation increased accretion of fat-free mass and enhanced linear growth in those that were stunted at baseline (Rivera et al, 1998). Similarly, in a double-blind placebo-controlled study in Viet Nam, growth of stunted children was improved by daily or weekly multi-micronutrient supplements providing zinc, vitamin A, iron and vitamin C (Thu et al, 1999). In Japanese boys of short stature with marginal zinc deficiency based on a zinc clearance test, zinc supplements improved the height velocity, but this was not observed in girls (Kaji et al, 1998). In Chile also, zinc supplements increased linear growth of stunted pre-adolescent and adolescent males, but not females, in a randomized placebo-controlled trial (Castillo-Duran et al, 1994). Zinc deficiency, with retarded growth among other signs, was first identified among adolescents

from middle-eastern areas where the diet included little animal sources of highly bioavailable zinc, and where bread was unleavened, which contributed to a low bioavailability of zinc owing to high phytate content (Sandstead 1991). Zinc-fortified bread was tested on a small scale in a case-control study of Turkey school-age children with low serum zinc levels. Positive results suggesting satisfactory zinc bioavailability were reported (Kilic et al, 1998). In adolescent monkeys, moderate zinc deficiency as sole dietary inadequacy was also shown to limit skeletal growth and mineralization (Golub et al, 1996).

These studies provide further supportive evidence for the involvement of zinc deficiency in stunting, perhaps more so in boys. Zinc may also prevent bone loss, as suggested by observations in older women (Strause et al, 1994). Further research should assess the effect of improved zinc intake (or zinc supplementation) during adolescence on the growth spurt, as well as on bone mass and density, in boys and girls. Zinc has other physiological roles, including immunity, and it interacts with several micronutrients, notably with iron (Whittaker 1998), and with vitamin A (Christian and West, 1998).

In summary, quite a few micronutrients are suspected to be in short supply in adolescence, at least in certain population groups. Remedial and preventive action strategies are discussed in the next chapter. There are many more minerals and vitamins for which deficiencies may occur. However, the purpose is to address those that represent threats to nutritional health at population level based on scientific knowledge to-date, and that are of particular relevance to adolescents' nutrition. Background information on other micronutrients and their deficiencies may be found elsewhere (Latham 1997; WHO 1997b).

3.2.3 Obesity and other nutrition-related chronic diseases

At the present time, cardiovascular disease and cancer are responsible for half as many deaths in the developing as in the developed world. However, this is changing as obesity and associated chronic diseases (cardiovascular disease and diabetes in particular) are increasing at a rapid rate in many developing countries, to the extent that diet-related chronic diseases are considered a new challenge in the Millennium (James 1998). Obesity has become a global pandemic and should be regarded as today's principal neglected public health problem (WHO 1998a).

3.2.3.1 Obesity

Obesity is increasing in most high-income countries, in developing countries undergoing nutrition transition, and even in poor countries with current food insecurity and undernutrition problems. In Ghanaian adults, for instance, underweight (BMI <18.4) is only slightly more prevalent than overweight (BMI >25) (International Obesity Task Force (IOTF))¹¹.

The body of data on prevalence of obesity and secular trends in adults is growing and there is now a coherent system available for use at the international level to classify adult overweight and obesity based on BMI (WHO 1998a). However, such data are lacking for children and adolescents, owing in part to lack of agreement and consistency in classification of obesity (see Section 4.3.1). A roughly twofold increase in the frequency of overweight or obesity was nonetheless reported over a twenty-year period in American and Japanese schoolchild groups (WHO 1998a).

In Europe, the prevalence of adult obesity has reportedly increased by about 10%-40% in the last 10 years, and the most dramatic increase (50% since 1980) has been observed in the UK¹. However, there is no specific data on adolescents. In a study on cardiovascular risk factors in Italian adolescents attending junior high schools (Rabbia et al, 1994), the prevalence of obesity, based on BMI reference data from the UK, was 24% in boys and 19% in girls, and 39% of the remaining boys and 38% of the remaining girls were in the overweight range. Interestingly, the prevalence was significantly higher in boys than in girls, which is at variance with most studies.

¹¹ Donald B. Brown Research Chair on Obesity, www.obesity.chair.ulaval.ca/IOTF.htm (14/05/99)

In the United States, the Third National Health and Nutrition Examination Survey (NHANES III, 1988-94) revealed that the prevalence of overweight has continued to increase (Update 1997). Roughly one third of adults were overweight (based on 85th percentile of NHANES II BMI for age, 1976-80) and 12% of adolescents (based on 95th percentile of BMI for age), which represents a twofold increase. In the Minnesota Adolescent Health Survey (Neumark-Sztainer et al, 1998), there was a strong inverse relationship between socioeconomic status and weight status in girls, but not in boys.

The situation in developing countries varies widely according to urbanization and income, but obesity is not merely a problem of high-income groups. In Cali, for instance, median BMI and skinfold values are higher than the American reference population for all levels of income, but it is significantly higher in the middle-income group (Pradilla, personal communication). In countries undergoing rapid economic growth, in China for example (Popkin et al, 1993), a nutrition transition is observed, with a progressive change of patterns of nutrition-related disease. In such contexts, undernutrition and overnutrition commonly co-exist. As problems of food scarcity are solved and incomes rise, there is a rapid change in the structure of diets and the level of physical activity. In China, it was found that overweight was emerging as a problem associated with young age, high income and urban adolescence (Wang, Popkin and Zhai, 1998), although the prevalence of 4% (85th percentile of reference BMI, NHANES II) was still quite low compared with developed countries. It can in part be ascribed to changing eating patterns and in this study, 27% of the some 4000 adolescents studied derived more than 30% of their energy from dietary fat and 16% had more than 10% of their food energy provided by saturated fat. It was also observed that urban girls from a lower socioeconomic status were more at increased risk of overweight than those of a higher income level. This higher rate of obesity in poorer groups is also typical in developed countries. Among Amerindians, for instance (First Nations of North America), obesity has become a serious epidemic, much like diabetes, which is associated with it (Gohdes 1995; Delisle and Favron, 1994; Delisle, Rivard and Ékoé, 1995).

In the Middle East, there have been several reports of increasing obesity among adolescents and adults. Based on a BMI cut-off of 25 for overweight or obesity, 16% of boys and 17% of girls in secondary schools in Bahrain were positive (Abdulrahman 1993). While obesity increased with age in girls, it declined in boys. A family history of obesity was a significant factor associated with obesity in both boys and girls. An interesting observation is that boys who ate alone were three times more likely to become obese than those who ate with family members. In United Arab Emirates (Amine and Samy, 1996), a 11% rate of overweight (110-120% reference weight for height) and 31% of obesity (120% of reference weight) were reported among female university students. The prevalence of obesity increased with age and was associated with obesity in childhood or in parent(s), as well as with between-meal food intake, particularly fast food, with limited physical activity and with long afternoon napping. In Kuwaiti college girls, Al-Isa (1998) reported that 27% were overweight (BMI>25) and 7% were obese (BMI>30). Obesity among parents and dieting were among the independent and significant factors.

Obesity and chronic malnutrition reflected in stunting often co-exist. They may even be interrelated, with more obesity among stunted people, which would tend to support Barker's hypothesis of increased chronic disease risk among people having been exposed to malnutrition in early life (Barker 1996; Leon et al, 1996). In poor areas of urban Brazil, for instance, it was found that obesity associated with stunting was more common than obesity without stunting, both in younger children and adolescents (Sawaya et al, 1995). A high risk of obesity among stunted children has also been described in other developing countries undergoing nutrition transition (Popkin et al, 1996). In such circumstances, however, a higher relative weight because of stunting may not reflect excessive adiposity (WHO 1998a), and cautious interpretation is needed. Adolescents who were growth-retarded at birth also tend to put on more weight during the growth spurt of adolescence (Léger and Czernichow, 1999). Another aspect that may further complicate the interpretation of adolescent anthropometry is that early maturing subjects are in general more obese in their twenties than slowly maturing adolescents, according to the Amsterdam health and growth study (Post and Kemper 1993; van Lenthe et al, 1996). It is suggested that early maturation which responds to genetic and environmental factors, including high level of nutrition, may be a risk indicator for the development of obesity.

The health consequences of overweight and obesity in adolescence have been thoroughly reviewed (WHO 1998a). Obesity-related symptoms in children and adolescents include psychosocial problems, increased cardiovascular risk factors, abnormal glucose metabolism, hepatic gastrointestinal disturbances, sleep apnoea (in children) and orthopedic complications. Obesity in adolescence may have serious health and psychosocial consequences. For some, the greatest hazards of adolescent obesity are the social and psychological difficulties that also may persist into the adult years (Lifshitz, Tarim and Smith, 1993), although for others, obesity in adolescence may have limited emotional implications (Elster and Kuznets, 1995). Adolescents are sensitive about body image and obese teenagers are especially vulnerable to social discrimination. Poor self-esteem and body image are consistently associated with obesity in adolescents, but not in younger children (French, Story and Perry, 1995). In women, obesity at adolescence may even affect future socioeconomic and marital status, according to a longitudinal study in the USA (Gortmaker et al, 1993).

The major long-term health problems associated with adolescent obesity are its persistence in adult life and its association with cardiovascular disease risk in later life. Obesity that persisted through age 12 raised the odds of adult obesity to 4 to 1 in the UK (Stark et al, 1981). Based on the Harvard Growth Study, males who were overweight at age 13-18 were found to be at increased risk of mortality five to six decades later, compared to subjects who were lean during adolescence (Must et al, 1992). In general, longitudinal studies suggest that obesity tracks into adulthood particularly if it is present in adolescence (Serdula et al, 1993). While a genetic component in the aetiology is acknowledged, environmental factors play a central role. High-fat diets and sedentary lifestyles are considered major causes (WHO 1998a). For instance, in a study among adolescent Cree Indians in Canada, it was found that the rate of obesity was high, and that it was associated, among other factors, with the amount of time spent viewing TV (Bernard et al, 1995), an observation that had previously been made in quite a few studies on childhood obesity. Foetal malnutrition as an additional risk factor has been discussed above.

It is estimated that half of cardiovascular disease mortality is nutrition-related, as well as 33% to 50% of type-2 diabetes cases (WHO 1990). In a 14-year longitudinal study of over 6000 obese subjects in Germany, it was found that in all age groups, there was an increased mortality risk with obesity, and the risk increased with the level of obesity as assessed on the basis of BMI (Bender et al, 1999). The obesity-related increased risk was higher in younger age groups, and declined with age. The highest mortality was observed in the group aged 18-29 years at baseline. In a long-term follow-up study of adolescents (Must et al, 1992), it was found that adolescent boys with a BMI above the 75th centile were at increased risk of death from all causes, from cardiovascular disease, and even from colorectal cancer, and both overweight boys and girls were at increased morbidity risk.

3.2.3.2 Cardiovascular disease risks

- *Atherosclerosis and blood lipids*

Obesity is defined as excess adiposity, and high BMI is merely an indicator. It is established that beyond the amount of body fat, its distribution affects metabolic disease risk. Even before adulthood, anthropometric measures of adiposity were found to be related to lipid and insulin concentrations, in a cross-sectional study of Bogalusa children and adolescents (Freedman et al, 1995; 1999). A central or abdominal distribution of body fat was related to adverse concentrations of triacylglycerides, LDL- and HDL-cholesterol, and insulin. This was observed, whether fat distribution was assessed by measuring waist circumference alone, after adjusting waist circumference for weight and height, or with the waist-hip ratio. Waist circumference showed the most consistent association with risk factors, which clarifies previously conflicting results on fat distribution and biological risk markers. Thus measuring waist circumference of adolescents, in addition to BMI, could help identify those who likely have adverse lipid and insulin concentrations, and who should be targeted for weight reduction and risk-factor surveillance. Freedman et al (ibid.) provide 50th and 90th percentile values for white and for black girls and boys, from age 5 to 17 (See Table in Appendix II). However, anthropometric indices of fat distribution may vary across population groups of adolescents as they do in adults (Karter et al, 1996) and therefore, additional studies in adolescents are required. Waist-hip ratios are also difficult to standardize in children because of changes in body habitus with normal development (Gidding et al, 1996).

Atherosclerosis can be recognized at postmortem, and it correlates with antemortem levels of lipids even in adolescents (Newman, Wattigney and Berenson, 1991). Fibrous plaques are often already evident in adolescence (McGill et al, 1997). In male adolescents for the Netherlands (but not in females), Lund et al (1992) found that dietary fatty acid profiles were significantly correlated with several parameters of plasma lipid status, notably with the ratio of total cholesterol:HDL cholesterol, which is a risk factor for coronary heart disease. In a study on over 500 Egyptian adolescent girls attending a middle-class school in an urban area (Hakim et al, 1997), one third had high blood cholesterol (total >200 mg/dl). It was also found that nearly two thirds were overweight, based on BMI >25. BMI and upper body fat pattern (subscapular/triceps skinfold) explained 25% of cholesterol variance. Tracking from childhood through adulthood of cardiovascular risk factors, which tend to cluster together, has been recognised (Freedman et al, 1985; Bao et al, 1994). Since atherosclerosis (and risk factors such as hyperlipidemia) begins in childhood and progresses into adulthood, as shown in many studies including Bogalusa and Muscatine (Lauer and Clarke, 1990), it is important to identify children and adolescents at higher risk based on obesity, upper-body adiposity, a family history and, when possible, current lipid abnormalities.

According to NHANES III (Hickman et al, 1998) as in previous surveys in the USA, it was found that mean total cholesterol was higher in female than male adolescents, and that the highest levels were found in 9 to 11-year olds. There was a declining trend, as in adults, from previous studies among all 12 to 17 year-old adolescent race/sex groups (Mexican-Americans, non-hispanic whites), except in black females, who had the highest total serum cholesterol levels, and who experienced the smallest decrease over time. This may be related to the higher observed rate of obesity among black adolescents, compared with Mexican-Americans and whites. The declining trend in serum cholesterol accompanies a decreasing level of total and saturated fat intake as % of total calories, and declining cholesterol intake, although intake levels are still too high. Overweight is also highly prevalent, and adolescents show a low level of physical activity. However, total serum cholesterol does not distinguish between “bad” and “good” cholesterol, which fluctuates during puberty. For instance, the decline of total cholesterol at puberty in males reflects the decrease of HDL-cholesterol.

- *Hypertension*

High blood pressure in childhood and adolescence may be associated with impaired foetal growth evidenced by low birth weight, and this was also observed in Africa (Pharaoh et al, 1998; Woelk et al, 1998). For instance, in the retrospective study in Harare schoolchildren (Woelk et al, *ibid.*), a slight but significant inverse association between systolic blood pressure and birth weight was observed, even after controlling for present body weight. Similar findings were reported in Jamaican schoolchildren (Forrester et al, 1996). In a 15-year cohort study of very-low-birth-weight infants in England, control matched for age, sex and school (Pharaoh et al, 1998), systolic blood pressure was significantly higher in cases than controls, and the difference was further increased after adjusting for anthropometric measurements. The difference from controls was 4-5 mm Hg, which is not unimportant. However, some of the variation could be attributed to socioeconomic differences, beyond foetal development, and according to the authors, it is plausible that adverse social and economic influences initiate their cardiovascular effects during intrauterine life, and are compounded during childhood, adolescence and adulthood. This is in agreement with the social patterning theory (Kuh et al, 1997) referred to in Chapter 2. The association between blood pressure and birth weight is reportedly less consistent in adolescents than in children or adults (Barker 1994). Other nutrition-related chronic diseases such as CVD, NIDDM and certain types of cancer may only appear in adult life, but are associated with dietary and lifestyle risk factors at adolescence, many of which are in association with obesity.

3.2.3.3 Nutrition, gout and gallstones

Overweight and obese adults are at increased risk for mortality and morbidity associated with many acute and chronic conditions, including gallbladder disease and gout.

Obesity, a high purine diet, and regular alcohol consumption are well-known risk factors for gout (Emmerson 1996). Evidence suggests that a sedentary lifestyle, and a diet rich in animal fat, in refined sugars, and poor in vegetable fats and fibre are also significant risk factors for gallstone formation

(Misciagna et al, 1999), whereas vitamin C may reduce the risk (Simon and Hudes, 1998). Vegetarians seem to be less susceptible to gallstones (Kratzer et al, 1997), whereas weight loss also seems to be associated with increased risk (WHO 1998a).

Whilst women seem at higher risk than men for gallstone disease, the prevalence of hyperuricemia (associated with gout) was found to be higher in men and to increase with age in Taiwan (Chou et al, 1993). Multivariate analysis revealed that blood pressure, creatinine, triglycerides, and organ meat consumption were significantly correlated with hyperuricemia.

This provides further evidence of the benefit of avoiding overweight and obesity, and of having an ample intake of fruits, vegetables, and high fibre grains, while limiting animal fat, meat, alcohol and perhaps also refined sugar.

3.2.3.4 Nutrition and cancer

It is clear that nutrients play a role in cancer, but the extent and specifics remain unclear. Research increasingly points to the important role of nutrition in preventing and contributing to cancer. However, the exact relationship between dietary components and cancer is not elucidated. There are more than 100 types of cancer, dietary components are biochemically complex, and they may increase or reduce cancer risk, case-control studies are difficult in humans, and cancer is long to develop so that it is difficult to show cause and effect relationships (Am Cancer Soc Research News, 1999). The questionable reliability of self-reports on diet in the distant past, going back to adolescence, may also be an issue (Wolk et al, 1997).

Many ecological, case-control and cohort studies provide convincing evidence of a preventive role of fruits and vegetables, including studies on the Mediterranean diet (Tavani and La Vecchia, 1995). Green leafy vegetables were found to be strongly associated with reduced ovarian cancer risk (Kushi et al, 1999). Guidelines of different health and nutrition agencies concur with the advice of having an ample consumption of fruits and vegetables as a means of reducing cancer risk. These foods are sources of vitamins, minerals, phytochemicals and fibre, which may help reduce cancer risk. In addition, individuals may as a result eat less fatty and energy-dense foods. In both men and women, a diet rich in vegetables appeared to reduce the risk of colon cancer. Cruciferous vegetables may be particularly beneficial. Antioxidant nutrients (vitamins and minerals), present in ample supply in fruits and vegetables, may play an important role in cancer prevention and in reducing the risk of cardiovascular disease, but specific recommendations may be premature. Other nutrients may be involved, to mention a few: selenium, calcium, iron, folate and vitamin B6 (Amer Cancer Soc Res News 1999).

Evidence of a protective role of fibre against certain types of cancer is sufficient for many health bodies to recommend a diet rich in fibre. Regarding fat, while evidence is so far inconclusive, the importance of avoiding a high fat intake is widely endorsed. Accordingly, review of many case-control studies provides supportive evidence of the hypothesis that wholegrain intake protects against many types of cancer (Jacobs et al, 1998). However, there is insufficient evidence to conclude on a role for sugar (Burley 1998). In the USA, national recommendations are to decrease intake of dietary fat and alcohol, and increase intake of fruits, vegetables and wholegrain cereals. There have been encouraging trends towards improvement consistent with reduced mortality from those cancers with the strongest association with diet: colon/rectum, breast, prostate (Krebs-Smith 1998).

In large prospectice studies, total fat was not shown to be associated with breast cancer, and it may not be a risk factor for colon and prostate cancer either, contrary to correlations found among countries between dietary fat and these cancers (Willett 1998). High red meat consumption may be associated with colon cancer independently from fat intake, and animal fat (but not vegetable fat) appears to be related to risk of prostate cancer. Excess body fat appears nonetheless to be an important factor of post-menopausal breast cancer and possibly colon cancer.

Information is therefore confusing in view of the many contradictory findings and international comparisons may be misleading. Furthermore, even if there is more knowledge regarding the preventive

effects of diet, it does not mean that eating behaviours will change accordingly. Before changes are even advocated, scientific evidence supporting such changes should be adequate. Food-based dietary guidelines are in this regard appropriate, as they are periodically updated to integrate new scientific knowledge, while being conservative enough to prevent irrelevant advice (see Chapter 4).

3.2.4 Tooth decay, a nutrition-related problem in adolescence

Tooth decay and periodontal disease may result from a combination of poor oral hygiene and poor eating habits. At this time, dental problems are more widespread in industrialized than developing countries. Education for dental hygiene and health and fluoridation of drinking water and toothpastes, and to a certain extent the use of sugar substitutes, are contributing to a reduction in numbers of cavities, filled and missing teeth. However, in developing countries, dental health may deteriorate rapidly as a consequence of dietary changes (see WHO 1994). Sucrose (table sugar) is the main cariogenic food ingredient, particularly when in a form that sticks to the teeth. Other mono- and disaccharides are also cariogenic, but to a lesser extent; lactose is the least. Starch is not, so that diets high in starch and poor in sugar have a very low-caries producing potential. It is also possible that high carbohydrate, unrefined foods have anti-decay properties (Rugg-Gunn 1993). These are typical features of traditional dietary patterns of many developing countries. However, partly hydrolysed starch as found in highly processed snack foods, may have an increased cariogenicity (Grenby 1990). With increasing consumption of sugar, processed foods and snack items by children, tooth decay may increase. The effects of dietary changes, such as those that occur in adolescence, combined with alcohol and tobacco consumption, may affect dental health (Lessard 1995). Another factor that may contribute to tooth decay is malnutrition during tooth formation (Alvarez 1995). It has been demonstrated in animals that early malnutrition affects tooth development and eruption, and increases tooth decay later in life. There is increasing evidence of similar effects in humans. Cross-sectional and longitudinal studies in Peruvian children showed that malnutrition, as evidenced by anthropometric status, not only delayed tooth development and affected the age distribution of dental caries, but was also associated with a higher number of carious deciduous and permanent teeth. Even mild or moderate malnutrition during infancy was associated with increased caries in both deciduous and permanent teeth. Dental enamel hypoplasia is also associated with malnutrition in the early years, although it is not a highly specific indicator of nutritional status (Goodman and Rose, 1991). Finally, periodontal disease may also be associated with undernutrition, in particular ulcerative gingivitis of infectious origin (Enwonwu 1994).

Thus, early malnutrition and dietary changes associated with adolescent lifestyles and socioeconomic development may lead to increasing prevalence of dental decay in adolescents and adults.

3.3 Early pregnancy, a well-documented factor of health and nutritional risk in adolescent girls

Pregnancy (and lactation) in adolescence is the condition that has been most extensively studied nutrition-wise. Recent review papers (Gillespie 1997; Kurz 1997; Treffers 1998) are available, and therefore only a summary of nutrition-relevant evidence is presented in this paper. Early pregnancy exposes mother and child to risk owing to potential competition for dietary energy and nutrients, and also because of physiological immaturity of the young mother. Furthermore, the more undernourished or stunted the young mother is, the more immature she may be for her age, and consequently the higher the level of risk.

It is estimated that 25% of women have their first child before the age of 20 (Senderowitz 1995). Early pregnancy is a problem worldwide, in high-, middle-, or low-income populations alike. There may be large differences among countries in the proportion of girls bearing a child before the age of 20 (Bongaarts and Cohen, 1998). The proportion may reach two thirds, as in Bangladesh, Cameroon, Mali and Niger, whereas it is below 20% in countries such as Morocco, Sri Lanka and Tunisia. Clearly, this has to do with differential social norms and permissiveness regarding sexual relationships and childbearing.

Adolescent pregnancy has begun decreasing, at least in the USA (Blum 1998). According to NCHS data¹², the US teen pregnancy rate has dropped 17% since peaking in 1990. Between 1995-96, the rate fell by 4%. The decline is attributed to increased use of contraceptives, as well as decreased sexual activity. Yet teenage pregnancy is still widespread. Physical growth, mental and sexual development of girls during adolescence may have a critical effect on their capacity to carry successful pregnancies, and the health and nutritional status of today's adolescent girls will largely determine the quality of the next generation (Ahmed et al, 1998).

Total nutritional requirements of pregnant adolescents who are at least two-year post-menarche are reportedly similar to those of pregnant adults (Gutierrez and King, 1993). However, the problem is that they often enter pregnancy with reduced nutritional stores and hence at increased risk of nutritional deficiencies. This may be due to unsatisfactory eating habits, or inadequate intake as a result of poor access to food, particularly in developing countries.

Do adolescent girls experience more poor outcomes of childbearing than adult women? Outcomes to consider are maternal mortality and morbidity, birth weights and prematurity, and lactational performance according to age, maturity and environmental factors. Socioeconomic consequences of early pregnancy also have to be addressed.

3.3.1 Maternal mortality and morbidity

Many studies have shown that adolescent girls have a higher maternal mortality rate than women aged 20-34 (Royston and Armstrong, 1989; Kurz 1997). As observed in Bangladesh, Nigeria and Jamaica, maternal mortality rates are particularly high among the youngest adolescents, that is 10-14 years of age. However, is age of and by itself a risk factor, once other factors, such as parity, socioeconomic status, physiological maturity and prenatal care adequacy, are taken into account? This is not as yet fully elucidated, although there is evidence in the USA that except for the least mature, the complications of teenage pregnancy are caused more by psychological and socioeconomic factors than by any physical immaturity (American Dietetic Association Reports 1994).

As for morbidity, the effect of first childbirth is not always easy to distinguish from that of young age, for instance, in the case of more frequent pregnancy-induced hypertension in adolescents than adults. However, the influence of age would appear small after considering primiparity (Kurz 1997).

There are several reports of increased cases of obstructed labour and obstetric fistulae among adolescent mothers, including the WHO review (Royston and Armstrong, 1989). Here again, the effect of mother's age is not easily distinguished from that of other explanatory variables. Nonetheless, since growth of pelvic bones continues in adolescence for several years after menarche, it is reasonable to think that young age might be implicated, at least among those who are not physiologically mature (Kurz, 1997). Short stature is associated in women with small pelvises and a higher risk of obstructed labour. It is a major cause of maternal deaths in developing countries, for instance 10-17% in Bangladesh (Royston and Armstrong, 1989). Height is a better predictor of risk of obstructed labour than age. It can also be added that maturity may be delayed in malnourished adolescent girls, which further increases the risk.

The rate of maternal anaemia according to age of mothers (adolescents vs adults) has not been documented.

According to studies in high- and low-income countries, women whose statural growth (and pelvic bone growth) is not complete when they become pregnant continue to grow during pregnancy. The gain in height during pregnancy may even be underestimated owing to frequent 'shrinking' of women during pregnancy as a result of vertebral compression caused by weight gain. Using knee height

¹² Reuters Health, April 29, 1999

measurements (length of lower leg) in order to avoid the height measurement problem, it was reported that 56% of adolescent girls in the USA continued to grow during pregnancy, and in multiparous ones, maternal growth was associated with lower birth weight (Scholl, Hediger and Ances, 1990). It is not known, however, whether growth in stature is as complete as it would have been in the absence of pregnancy, and whether the slowed-down growth has adverse consequences per se. As mentioned already, micronutrient supplements (iron and folate) promoted growth in undernourished pregnant Nigerian adolescents (Harrison et al, 1985).

3.3.2 Low birth weight and prematurity

Young age was not shown to have an independent effect in meta-analyses (Kramer 1987). However, those factors that had an independent effect were found to occur more often among young adolescents. Comparing younger (less than 18 years) and older mothers (21 years and above) in the Philippines, and controlling for many potential confounding variables, a higher incidence of low birth weight and prematurity was found among younger mothers. Similar findings were reported in urban Mali and Burkina Faso (Kurz 1997). Even in the USA, higher rates of prematurity, low birth weight and neonatal or postneonatal mortality are observed in babies born to adolescent mothers (Rees et al, 1992). Another study in the USA showed a nearly twofold increase of low birth weight or prematurity risk among 13-17 year-old first-time mothers, compared to those aged 20-24 years at first pregnancy. Younger mothers were also found to have a higher incidence of poor child health care, poor child feeding behaviour and child mortality in the African studies mentioned above. In the Latin American studies of ICRW, the nutritional status of children born to younger mothers was lower at 4 and 10 years of age than children of older mothers (Buvinic 1998). Psychological development also appeared less satisfactory. However, these disadvantages associated with teenage mothers were only apparent in poor groups, which shows that adverse socioeconomic conditions of adolescent mothers have a profound impact.

In the USA, it was found that pregnant adolescents who were still growing in stature, according to knee-height measurement, and those who were primiparous, had lower birth-weight babies than multiparous or adolescents who had stopped growing (Scholl et al, 1990; 1993). It seems that when the mother is still growing, there is competition with the foetus for energy and nutrients from the diet, which would explain that for similar pre-pregnancy weights and weight gains during pregnancy, the adolescents who were still growing in height had smaller babies than those whose growth had stopped. However, there is a dearth of information on food (and other health-related) behaviours in pregnant adolescents, compared with pregnant adult women.

3.3.3 Lactational performance

Some studies suggest a poorer lactational performance of adolescent mothers, although lactational behaviour and many other factors that are at play may not be fully controlled for. Scientific evidence of adverse effect of adolescent pregnancy on lactation is still lacking. Motil et al (1997) reported in a comparison of 11 adults and 11 adolescents of diverse ethnic backgrounds that adolescents' production of milk up to six months postpartum ranged from 37-54% less than that of adults, but milk composition was similar. It was also found that adolescents lactated for a shorter period of time than adult women, and that they tended to introduce supplemental formula feedings early. These differences in lactation behaviour did not explain milk production differences however, and the authors suggest the possibility that other biological factors may influence the lactational performance of adolescents. It may be that the adolescent is incapable of producing a full complement of milk comparable to that of the adult because of developmental immaturity of the growth process relative to her reproductive capacity (Scholl et al, 1993). There is potential competition between the metabolic needs of the mother for her own maturation and those for milk production. Indeed, it was observed that lean body deposition occurs in adolescents concurrently with milk production, so that there is a dual metabolic challenge (Motil et al, 1996). There were, however, large differences in body weight and height of adolescents and adults, and controlling for such differences may have reduced the significance of differences in milk production. In India, a study also showed that adolescents lost more weight during the first three months of lactation than did adult women (Geervani and Jayashree, 1988).

Thus, more than young age per se, the following factors often associated with young age are primarily responsible for negative consequences of childbearing (high maternal mortality and morbidity; low birth weight and prematurity): incomplete growth, primiparity, inadequate prenatal care, and low socioeconomic status. Since young age is implicated in the poor health consequences, the incidence of such consequences could be reduced if pregnancy were to be postponed into the mother's adult years, or at least until 18. In populations where undernutrition is widespread, maturation is also delayed. It has been suggested that if the risks of overlapping growth with pregnancy are to be avoided, the first pregnancy should be postponed until girls are at least 19 years of age (Kurz, Peplinski and Johnson-Welch, 1994). It is also reminded that menarche is not a good indicator of optimal readiness for pregnancy since growth continues for 4 to 7 years afterwards, although at a slower pace.

3.3.4 Socioeconomic consequences and correlates

Apart from nutritional risk, there is concern that single motherhood in adolescence may result in adverse consequences for mothers and children, and contribute to the reproduction of poverty from one generation to the next, as suggested by a review of ICRW studies conducted in the Latin American/Caribbean region (Buvinic 1997; 1998). Such negative effects of teenage childbearing are documented in the USA. However, it is important to compare with adult childbearers in order to control for confounding factors, and to study cases over a long enough period in order to verify whether the disadvantages are only transitory or long-lasting.

In the ICRW studies (Mexico, Chile, Barbados and Guatemala), it was found that early childbearing had more marked economic than social effects, and for poor rather than for all mothers. Early childbearing was associated with a larger family size, a tendency for female offspring also to have early pregnancy, and to perpetuate poverty of low-income women. It is only among the poor that early pregnancy has a negative influence on the child's nutritional status (height). It is also only among the poor that adolescent childbearing depresses mothers' monthly wages. Lastly, it is only among the poor that the mother's contribution to household income has a positive influence on the child's nutritional status, whether this is due to additional income, greater control of women over family budgets, or the greater competence of those mothers who can both earn income and raise children (Kurz 1997).

As summarized by PAHO¹³ before its recent international conference in Brazil on strategies to combat teenage pregnancy, poverty increases the risk of teenage pregnancy: in countries of the region with medium-to-high fertility rates, approximately 70% of pregnant adolescents belong to the most disadvantaged groups, and the rates are even higher in rural areas. Studies in Chili and Mexico indicated that 75% of pregnant adolescents were themselves daughters of adolescent mothers.

In a longitudinal study under way in north-east Brazil (Vieira Bruno and Bailey, 1998), it was shown that becoming a new mother disrupted the education of many girls, and this may be one mechanism for early pregnancy to perpetuate poverty, by interfering with schooling. In this study, it was found that adolescent pregnancy would not be equated with unwanted pregnancy, however: 40% of the prenatal group of adolescents said that they wanted to have a baby when they became pregnant. It was noted that for many teens, having a baby is one way of boosting their sense of self-worth. The implication is that interventions have to be designed to decrease adolescents' desire to have a baby, which is different from preventing unwanted pregnancies. Whether or not the 'intendedness' of pregnancy had an impact on child development at one year is among the questions that the Brazil study is in the process of answering. There are no such studies in Africa or in Asia, which is unfortunate because the issues are undoubtedly modulated by culture.

¹³ <http://www.paho.org>, Aug.13, 1999

Delaying the first pregnancy therefore appears imperative particularly among low-income groups, because early pregnancy appears to entrench the poverty of low-income women, it is associated with larger family size, and because teen mothers tend to beget teen mothers. Providing education and income for the family are two positive factors that may tend to break the vicious cycle of early childbearing and poverty for women and children (Reed, Habicht and Niameogo, 1996). Social policy along those lines may contribute to breaking the cycle of poverty. Nutrition intervention among adolescents and as part of antenatal care may also make a substantive contribution to breaking this vicious cycle (see under Section 2.4, and Chapter 4).

3.4 Lifestyle and eating patterns, major threats to adolescents' nutritional status

Nutritional problems of adolescents, whether undernutrition or nutrition-related chronic diseases, are mainly the result of dietary inadequacies, which may be related to a number of factors that can be grouped under physiological, socioeconomic, and psychosocial factors (see Fig. 1).

Growth imposes additional nutritional requirements in adolescence, and these requirements are further increased in pregnancy. Such high requirements mean that adolescents are exposed to not meeting them. Socioeconomic factors have a pervasive influence on quantity and quality of diets, irrespective of lifecycle groups; adolescents are not different in this respect, perhaps with the exception of the great influence upon their eating habits by the commercial environment, particularly mass media. Psychosocial factors are probably those with particular importance during adolescence. The search for identity, the struggle for independence and acceptance, and concern about appearance, are changes that may have a great impact on lifestyle, eating patterns and intakes of adolescents (Spear 1996), as discussed below.

3.4.1 Typical eating patterns and intakes of adolescents

How do intakes of adolescents compare with those of adults? It may be hypothesized that in most settings, the diet of adolescents is likely less adequate than that of adults, to begin with because of their eating patterns. However, the bulk of the information comes from high-income countries, and particularly the USA, where several surveys have been conducted on adolescents' health, nutritional status, dietary behaviours and intakes. Adolescent girls may be even more at risk of inadequate intakes for various reasons: dieting, discrimination, early pregnancy, lower energy intake than boys. And yet, girls usually have better eating habits than boys and they are more concerned about healthy eating (Dennison and Shepherd, 1995), when they can exert their choice, and provided dieting does not interfere.

According to a large body of dietary survey data collected in the USA, it appears that some dietary patterns are consistently observed among adolescents, and put them at risk of unhealthy eating: the consequence of snacking, usually on energy-dense but otherwise nutrient-poor items; meal skipping; irregular eating patterns; and a wide use of fast food for meals and snacks. These food habits may also apply in varying degrees to adolescents in other parts of the world. Other eating behaviours generally recognized as common among adolescents are eating away from home, low intake of fruits and vegetables, and in some instances, of dairy products as well; and weight concerns leading to faulty dieting practices, particularly in girls (Forthing 1991; Perry-Hummicuft and Newman, 1993; Gutierrez and King, 1993). Adolescents may also try unconventional dietary practices, such as vegetarian diets, which may reflect their propensity to adopt social causes and explore different philosophies (Johnston and Haddad, 1996).

Breakfast is often missed: more than 50% of respondents in the National Adolescent School Health Survey (US Dept Health and Human Services, 1989). Snacking was reported by 90% in the same survey. Only 39% reported eating nutritious snacks, the others describing snacks of "junk" food: chips, soda, sweets and cake (Portnoy and Christensen, 1989). Wisely chosen snacks are important, however, as energy requirements of adolescents are high. Indeed, it was reported in the USDA Nationwide Food Consumption Survey that snacks provided up to one third of adolescents' daily energy intake, and a significant amount of micronutrients (Bigler-Doughten and Jenkins, 1987). Fast foods are popular choices among adolescents, and this can contribute to high intakes of saturated fat. Based on NHANES II and the

National Adolescent School Health Survey, it was observed that adolescents who obtained breakfast and lunch foods from sources other than home or school were more likely to consume high-fat, low nutrient-dense snacks, as well as dieting over the previous year (Douch et al, 1995).

In Australian adolescents, inadequate consumption of fruits, vegetables and dairy products was also observed (Nowak and Speare, 1996). In the USA, it was found that adolescents frequently had intakes of vitamin A, vitamin E, calcium, magnesium and zinc below recommended levels (Johnson et al, 1994). Females also had low intake levels of phosphorus and iron. At the same time, diets were high in some nutrients related to increased risk of chronic disease (total fat, saturated fat, sodium). Female adolescents were considered at higher risk of inadequate intakes of micronutrients owing to a lower intake of food than males; they would need to make careful food selections. African American females from the Southern USA were at particularly high risk.

It was observed in a study among adolescents in Switzerland (Cavadini et al, 1999) that less than 50% consumed milk or dairy products daily. Girls consumed less soft drinks and meat, but more fruits and vegetables than boys. In spite of this, daily consumption of fruits and vegetables was low, particularly in the older group of adolescents. These findings are quite similar to other European and American studies (Muñoz et al, 1997).

The Minnesota Adolescent health survey conducted in 1986-1987 in the USA on 30,000 adolescents (Neumark-Sztainer et al, 1998) yielded a wealth of information about adolescent nutrition, some of which may have practical applications also in developing countries. This survey provided a unique opportunity to assess the prevalence of nutrition-related items in a large and diverse adolescent population, and to examine their relationship with a range of sociodemographic, psychosocial, and other health-promoting and health-compromising behaviours. Major concerns identified included the high rate of inadequate consumption of fruits, vegetables and dairy products, unhealthy weight-control practices and overweight. Inadequate consumption of fruits and vegetables was more widespread in adolescents from low socioeconomic backgrounds. American Indians were at greatest risk of inadequate fruit consumption, and African Americans, of inadequate vegetable consumption (Neumark-Sztainer, Story and Blum, 1996). Psychosocial correlates of inadequate consumption included low family connectedness, weight dissatisfaction, and poor academic achievement. In another study, girls were more likely to have eaten fruit and vegetables the previous day, and less likely to have eaten high-fat meats and snacks than boys (Dinger and Waigandt, 1997).

It is observed that the busy lifestyle of today's families in the USA often results in adolescents skipping meals or relying on snack foods for basic nutrition. In the national survey of 1987, from 34% to 45% of school teenagers skipped breakfast at least four days a week, almost half reported eating three snacks a day, 60% of this food being high in fat but otherwise low in nutritional quality (American School Health Association 1989). It may be difficult for western adolescents to have a balanced diet, considering that snacking represents an increasing part of their food intake, and that the most popular and widely available snacks are high in sugar or in fat (Bull 1992). Even in Europe (France), fast-food attraction was shown to be very strong among adolescents, but mainly among the youngest, the boys, and the foreign (Chauliac and de Beco, 1996). In developing-country adolescents, eating "on the go" may also be common, and street foods represent a major dietary contributor. In Nigeria, for example, it was reported that street foods contributed 21% (boys) and 29% (girls) of adolescents' energy intake, 50% of dietary protein, 64% of calcium, and almost 60% of vitamin A (Oguntona and Kanye, 1995). In contrast with western snack foods, however, street foods often provide nutrient-dense traditional dishes in developing countries.

3.4.2 Commercial, cultural and psychosocial influences on eating patterns

Adolescents are greatly influenced in their eating habits by peers, mass media, social and cultural norms, and lack of nutrition knowledge, while the influence of the family tends to decline (Forthing 1991; Johnston and Haddad, 1996; Spear 1996). Adolescence is a time of high vulnerability to societal and peer pressure, often reinforced by the media, as may be evidenced by conformity, among other things, in behaviours, attitudes and dietary practices (Johnston and Haddad, *ibid.*). While being under possibly considerable pressure from the outside world to conform to current trends, in foods as in other behaviours,

adolescents are in the process of adopting eating patterns that may well form the basis of their dietary habits for much of their lives (Bull et al, 1992).

The media exerts important and underrecognized influences on children's and adolescents' health and behaviour in the 1990s (Strasburger and Donnerstein, 1999). Impact on high-risk behaviours is more documented than impact on nutrition-related practices, although some studies suggest that commercial advertising has a key role in shaping eating patterns among children (Jeffrey et al, 1982; Goldberg 1990; Dubé 1995). Furthermore, the media exerts an important displacement effect, at least in the USA, for 2 or 3 hours per day of television viewing or video-game playing means less physical activity, not to mention reading and interacting with friends.

Television and magazines probably have more influence than any other form of mass media on adolescents' eating habits, at least in developed countries (Spear 1996). There are corroborating examples for developing countries as well. In urban schools of Nepal, for instance, a study among pupils aged 9-11 from middle-income families revealed that 'fast food' (ready-to-eat snacks, potato chips, noodles...) was preferred by more than two thirds. Taste, convenience and affordability were the foremost preference criteria. The role of advertizing was considered relevant for 80% of them. With increasing fast-food consumption, that of more traditional (and nutrient-dense) food items such as pulses, green leafy vegetables, fruits and milk decreased significantly (Sharma 1998).

Adolescents' perceptions on health and health-related issues have been studied mainly in developed countries (see, for instance, Cordonnier 1995), but it appears that health concerns are not predominant among adolescents. This may stem from their limited preoccupation for the future (Greene 1986). In a participatory study on adolescent knowledge, values and coping strategies in relation to health in urban Kenya (Balmer et al, 1997), emerging sexuality, drugs and alcohol ranked at the top of the list of concerns, and politics, language and leisure and sports at the bottom of the list. It is revealing that apart from STD/AIDS, health (or food) did not emerge as a concern, nor as a value, while parents' love, education and honesty were highly rated. In Cameroon (Kurz and Som, 1998), health perceptions were the same irrespective of age and sex; however, there were differences according to residence. Urban adolescents perceived that they were in better health than their rural counterparts; similarly, city adolescents were more concerned with their health than rural adolescents.

Adolescents are not a homogeneous group, however, and there may be major variations in determinants of food choice according to age, sex, socioeconomic status and cultural norms. Shepherd and Dennison (1996) provide an insight based on study findings. It can be said that in adolescents like in other groups, taste preferences are a major determinant of food choices. Nutrition knowledge per se is little predictive of eating behaviours. While recognizing that they often have poor food habits, American adolescents typically cite the lack of time, discipline, and a sense of urgency as barriers to altering their dietary behaviours (Story and Resnick, 1986). The relative influence of parents and peers may vary across cultures and sub-cultures, but a general trend is for social and external factors in general, and peers in particular, to become increasingly significant with transition to adolescence (Contento et al, 1988).

Psychosocial models that are particularly relevant to explore and explain eating behaviours of adolescents are described with the intervention strategies (see Chapter 4). It remains that adolescents' perceptions of their food and of influences upon their choices are poorly understood, particularly in developing countries. Little is known indeed on nutrition-related perceptions, attitudes and behaviours in developing-country adolescents, apart from ICRW research findings. More research work should focus on documenting psychosocial and other determinants of eating behaviours, in order to be in a better position to modify them.

3.4.3 Body image, obesity, dieting and eating disturbances

Cultural values, and in particular, cultural aspects of body-size perception, may be important in explaining attitudes and practices relative to obesity, as discussed below. Body image, and its disturbances, is a critical determinant of dietary practices and nutritional risk at adolescence, particularly among girls.

3.4.3.1 The concept of body image

The concept of 'body image' has become nearly synonymous with the physical appearance-related aspect of the notion, and it is currently defined as made of three components: perception of body size and its accuracy; a subjective component of feeling satisfied or not with one's body; and a behavioural aspect (Heinberg, Wood and Thompson, 1996). Body image is important in adolescence, and disturbances are in relation with obesity, dietary disorders and psychological discontent. Based on available evidence, concerns with body image exist across gender, BMI and ethnic groups. Dissatisfaction with body weight and shape is widespread, probably more so in Caucasian adolescents, and it is not only associated with overweight. These issues need to be addressed by all those who work with youth.

Many theories have been proposed to explain body image disturbances and their link with eating disorders, but most researchers appear to agree that the strongest influence in western societies is the sociocultural factor, the theory which is best supported by available data (Heinberg, Wood and Thompson, 1996). Historically, and until societies no longer have food availability problems, fatness has been the ideal, and a sign of health and prosperity (Brown and Bentley-Condit, 1998). With economic development and affluence, there is a progressive shift towards thinness as the ideal body habitus and even the social norm, while obesity becomes more widespread as a result of increased access to high-fat processed foods and to motorized transportation and hence a sedentary lifestyle. Socioeconomic status is negatively associated with obesity prevalence in high-income countries, and still positively in poorer countries, but there is a progressive shift towards the western pattern with economic development, and with increasing prevalence of obesity (Popkin et al, 1993).

3.4.3.2 Body image and dieting practices

In the Minnesota Adolescent Health Survey (Neumark-Sztainer et al, 1998), 12% of girls reported chronic dieting, 30% binge eating, and 12% self-induced vomiting. Such disordered eating behaviours were also high among non-overweight girls. Dissatisfaction with weight was highly prevalent even among the non-overweight girls (and some boys). It is of major concern, since body dissatisfaction is the strongest predictor of disordered eating behaviours (Neumark-Sztainer, Butler and Palti, 1995), whereas a positive body image was a strong protective factor. Higher rates of body satisfaction, lower perceptions of overweight, and less dieting were observed in African-Americans than in white girls. Some of the risk factors for intake inadequacies and unhealthy weight-control practices included low SES, minority status, poor school achievement, low family connectedness and weight dissatisfaction. Preferred body size and the prevalence of obesity were found to be similar in Russian and in white-American adolescent girls, but overweight was less likely to be an important concern among the Russian than the white-American girls (Stevens et al, 1997).

In a large survey among school adolescents in New England, the USA, the profile of those who engaged in weight loss, and in weight- or muscle-gain behaviours, was studied (Neumark-Sztainer et al, 1999). These behaviours were highly prevalent, which indicates the strong concerns about body weight, size or shape. The most frequently reported behaviour for weight control was, encouragingly, exercise, followed by dieting. Interestingly, African-American and Hispanic girls were less likely than Caucasians to diet and exercise, but were more likely to report behaviours aimed at weight gain. Girls with BMI >95th percentile were at greatest risk of disordered eating behaviours (vomiting, diet pills, laxatives or diuretics). Older age and lower SES were additional risk factors. Relatively high rates of disordered eating were observed in African-American and Hispanic boys (7%, vs 2% in Caucasians).

In Australia (Nowak and Speare, 1996), gender differences were found in food-related attitudes and behaviours. For instance, girls were more concerned than boys with their weight, and more felt guilt about eating; while girls showed more health concerns in choosing their food, there were more girls than boys who would sometimes eat out of boredom. It was also found that body image, body weight, and food-associated beliefs and behaviours of 12 to 15-year-old students who had attempted weight loss were significantly different from those of students who had not (Nowak 1998). Interestingly, it was

observed in the same study that adolescents who were satisfied with their body exercised more frequently than the dissatisfied ones, whether it was a cause or an effect.

3.4.3.3 Eating disorders and disturbances

Eating disorders and disturbances have become the third leading chronic illness among adolescent females in the USA and other high-income countries (Fisher et al, 1995). The increasing number of adolescents diagnosed for such disorders may be ascribed to a combination of true increasing incidence, better case-finding, improved public awareness and expanded definitions (Rosen and Neumark-Sztainer, 1998). Anorexia nervosa or bulimia represent only one extreme of a broad spectrum. These conditions, once considered as afflictions of exclusively affluent Caucasian adolescent and young adult women, are now observed in younger people, in males, in not so affluent groups, and among non-Caucasians (Gard and Freeman, 1996; Rosen and Neumark-Sztainer, 1998; Story et al, 1995; Wifley et al, 1996). To our knowledge, however, there are no published studies on this problem in developing countries.

Anorexia nervosa is less common than bulimia and tends to start in somewhat younger adolescents (Elster and Kuznets, 1995). Binge eating and night eating syndrome are eating disorders that are primarily found among obese persons. Although there is no clear evidence that these psychological conditions are the primary cause of people becoming obese, they are connected with the obese condition, since these and other eating disorders are as yet rare in cultures where obesity is not a social stigma (WHO 1998a).

In modern societies where thinness is rather consistently emphasised, concerns about body weight are increasing and becoming evident at increasingly young age, particularly among girls (Dennison and Shepherd, 1995; Fox et al, 1994). Many emotionally healthy adolescents exhibit some signs associated with pathological eating disorders. The unique and striking characteristic of eating disorders is the adolescent's unrealistic and relentless pursuit of thinness. Among girls, concern and preoccupation with thinness is related to SES, race and ethnicity (Moses, Banilivy and Lifshitz, 1989). White and Hispanic girls tend to perceive themselves as overweight more frequently than do black females (Centers for Disease Control and Prevention, 1991).

Athletes who need to maintain a certain weight for competition may resort to extreme weight-loss measures that can impair both performance and health (diet pills, laxatives, starvation, etc). Weight and dieting concerns of adolescent athletes place them at greater risk of eating disorders (Anderson et al, 1995), and low-energy diets are more likely to be inadequate in micronutrients such as calcium, iron, magnesium, zinc and vitamin B6 (Loosli and Benson, 1990).

There may be in adolescents extreme commitment to diet and exercise. Examining the relationship between obligatory exercise and eating disorders among adolescents, it was reported that obligatory adolescent exercisers (those for whom exercise is the central focus of their lives), who may be compulsive exercisers, displayed more disordered eating attitudes and traits than non-obligatory exercisers (Brehm and Steffen, 1998). However, unlike in eating disorders, obligatory exercisers did not show more dissatisfaction with their body shape than the non-obligatory exercisers; BMIs were not different either. The incidence of obligatory exercise among Caucasian females was higher than expected. Non-Caucasian adolescent girls may not feel as compelled to conform to mainstream society's "thin ideal". Also, sports that emphasize appearance, competitiveness, and lean body mass may be conducive to the development of both eating disorders and compulsive exercise.

3.4.4 Interrelationships of eating and other health-related lifestyle factors

Studies show that healthy eating and healthy lifestyle in general are frequently associated (Neumark-Sztainer et al, 1997). Conversely, adverse behaviours such as drinking, smoking, lack of physical activity, overeating and poor dietary choices tend to cluster together (Woodward, Bolton-Smith and Tunstall-Pedoe, 1994). The relationship of exercise and sports, body image, and dietary practices was explored in American adolescents (Rainey et al, 1998). A dietary score was calculated based on type of food eaten the day before. Girls were more likely to be dissatisfied with their body image and to diet, but also, to

have better food habits than boys. Adolescent boys were more likely to exercise, and to be satisfied with their weight. Some racial and gender differences were confirmed in this study. Caucasian adolescents had the best diet quality score. Caucasian females were most likely to perceive themselves as overweight and to attempt weight loss, while males (especially those of African American backgrounds) were more likely to want to gain weight. Participation in athletics appeared to have a positive effect on eating habits.

Health-compromising behaviours such as binge eating, substance abuse and past suicide attempts were found to be correlated with inadequate intake of fruit and vegetables in the Minnesota Adolescent Survey (Neumark-Sztainer et al, 1997).

In Australia, it was found in 18-year-old boys and girls that cardiovascular disease (CVD) risk factors were related to smoking, “unsafe” drinking, and physical inactivity, particularly in females. Systolic blood pressure was positively associated with weight-for-height (as % of standard) and with unsafe drinking, while it was negatively correlated to fitness and birth weight. Total cholesterol was also negatively correlated with fitness. It was observed that 24% of males, compared with twice as many girls, had low usual level of activity, and that total cholesterol was higher in females, while blood pressure was higher in males (Milligan et al, 1997).

The Bogalusa Heart Study (Newman et al, 1986) already showed that cardiovascular disease risk factors in early life track into adulthood. It would therefore appear that it is important to detect subjects at risk for CVD as early as possible so that preventive strategies can be started. A possible strategy could be a change in lifestyle (smoking behaviour; dietary habits; physical activity) in youth. In the longitudinal Amsterdam Growth and Health Study which began in 1977 with subjects aged 13 years, the relationship between lifestyle during youth and young adulthood (from 13 to 29 years) and risk factors for cardiovascular disease at adult age was investigated. Diet, level of physical activity and smoking behaviour were carefully studied over the 15-year period. Anthropometric and biological parameters (lipoprotein levels, blood pressure, physical fitness) were also measured. The study revealed that long-term exposure to smoking behaviour was associated with a more adverse lipoprotein profile (lower HDL and higher LDL levels), but neither smoking nor alcohol consumption behaviour (which was light) were associated with higher blood pressure. A major finding is related to level of physical activity, which showed a significant inverse relationship with body fatness (sum of skinfolds), and a trend for a more favourable lipoprotein profile (Lund et al, 1992; Twisk et al, 1997). It would therefore appear that a major change to be encouraged during adolescence and youth is increasing physical activity levels. No long-term effect of diet could be detected, but only fat, carbohydrate and protein were considered. These findings do not rule out possible long-term impact of adolescent lifestyle, for size of sample was small, lifestyle values were averaged over the many measurements, and diet-related assessments were rather crude.

The level of physical activity tends to fall significantly at the time of adolescence. Studies have reported that the average American college student fails to meet the current physical activity recommendations of the American College of Sports Medicine, which involve at least three times per week of vigorous activities for cardiorespiratory endurance, a minimum frequency of three times a week for flexibility exercises, and twice a week for strength/endurance activities (Dinger and Waigandt, 1997). Vigorous activity was reported by 45% and moderate activity by 46% of respondents. While females engaged in flexibility and moderate physical activity more frequently than males, the reverse was true for vigorous exercise and strength/endurance activities. Self-efficacy, social support and exercise enjoyment have been found to be important determinants of leisure-time physical activity (US Department of Health and Human Services 1996). Social support may be more important for females than males (Calfas et al, 1994). Female adolescents tend to be less active than boys (Robinson and Killen, 1995), in the USA. In a study among college students in Australia (Leslie et al, 1999), it was found that 42% of girls and 32% of boys were insufficiently active (the cut-off is 800kcal/week, which is roughly equivalent to 30 minutes per day of moderate exercise). Social support, self-efficacy and enjoyment were again key factors, which are amenable to change. In Italy, there was a strong association of sedentary lifestyle or obesity with high blood pressure in adolescent students. It was observed that no more than 20% of children spent more than four hours per week doing physical activity (Rabbia et al, 1994).

In low-income countries in contrast, adolescents' livelihoods may involve heavy physical work, which has a direct bearing on their energy requirements, and their weight status. In a study among rural adolescent girls in Malawi, Fazio-Tirrozzo et al (1998) found that they all reported responsibility for a range of domestic tasks and 82% for farmwork. In the farming season, 67% were expected to do manual work for at least four hours a day. Low BMI (<2nd percentile of UK reference data from Cole, Freeman and Preece, 1995) and stunting (<2nd percentile of height-for-age, same reference population) was observed in 38 out of 110 girls (roughly 40%). Is heavy physical work as often required and part of livelihood systems in rural developing areas part of 'lifestyle'? It has been argued that while 'lifestyle' is something one chooses, life (or livelihood) is something that happens to one... (Fitzgerald 1994).

3.4.5 Socioeconomic factors and risk of inadequate diets

As pointed out by PAHO (1997a), many of the factors that underlie unhealthy development in adolescents stem from the social environment, including poverty and unemployment, gender and ethnic discrimination, and the impact of social change on family and communities. The constraints to improving adolescent health that these conditions impose have to be recognized, for health programmes can seldom directly focus on social inequity reduction. Many of these factors also impinge on nutrition, particularly through inadequate access to food, or unhealthy dietary patterns.

3.4.5.1 Gender inequality

It is plausible that parents allocate food and other resources differently depending on whether the child is a boy or a girl. Studies on gender discrimination in relation to nutrition have primarily focused on children, and there is more evidence of such discrimination against girls in Asia than in Africa (Walker 1997). Relatively little is known, however, about how poor households around the world allocate resources for education, health and nutrition among adolescent boys and girls, and other household members. Yet, this information is critical for policies and programmes targeting adolescents. Adolescent girls and women may be at a disadvantage with respect to household food distribution, as observed, for instance, in Nepal (Gittelsohn 1991). The findings of a study on these issues in the Philippines point to the need for such information (Bouis et al, 1998). It was observed that in poor households, adolescent boys and girls make major contributions to their family's welfare, and that they work about equal amounts of time in a combination of household chores, farm work, and wage employment. But girls put an extra 12 hours per week in school. Surprisingly, it is not gender, but the demand for education by the adolescents themselves that is the key factor influencing the amount of education they receive, and girls are keener than boys. Boys spend relatively more time in farm work and relatively less in household chores. The study finds no inequality associated with gender in the households surveyed. Both boys and girls in these poor families do hard work, have inadequate diets, particularly in nutrients provided by non-staple foods, receive poor medical care, and their education is cut short because of insufficient resources. Even though there is no gender inequality, girl adolescents may be more affected by dietary inadequacies than boys, particularly in iron, and the author advocates iron supplementation as a short-term solution, for only large increments in household income could allow a higher intake of non-staples to meet iron requirements.

3.4.5.2 Poverty and lack of access to food (food insecurity)

The ICRW studies highlighted relationships between intake of adolescents, SES, and food availability, but there was no gender difference in the level of intake adequacy relative to recommended intakes. Based on answers to questions on food availability in the last month, trimester or year, it was found that food security was a problem among low socioeconomic groups in Ecuador, and an even greater problem in Benin, where 86% of families reported food insecurity, even food-producing households. This problem was further aggravated by seasonal variations. This is in accordance with individual intake data, which showed inadequacies in Benin, particularly during the lean season.

In Cameroon, low SES of household was the best predictor of poor nutritional status in adolescents (low IMC, low intake of energy, protein, iron) (Kurz and Som, 1998). Therefore, adolescent dietary

intakes may reflect the level of household food availability. When assessed by individuals themselves, food security appeared even less satisfactory than food intake: 27% of low SES respondents in Ecuador reported household food problems (de Grijalva et Grijalva, 1994); 86% of households in Bénin (Inoussa et al, 1994). Among adolescents of Jamaica (Walker et al, 1994), 33% reported going to bed hungry at least once a week. In Cameroon, Kurz and Som (1998) found by multiple regression that low SES and residence in the Sahel were significantly associated with low-energy intake.

In India, Rani and Sehgal (1995) observed that adolescent girls' intakes of energy, protein, calcium, thiamin and riboflavin were significantly higher in rural than urban areas, but that whether urban or rural, mean dietary intakes were below the recommended intakes for energy and many nutrients. In most instances however, except in poor periurban areas, nutrition appears better in urban than rural areas, as in Nigerian adolescents (Brabin et al, 1997).

STRATEGIES AND APPROACHES TO IMPROVE ADOLESCENTS' NUTRITION

This section deals with action for nutrition in adolescence, after having reviewed the issues and justified the need to address them in previous sections. General strategies, models and programmes targeting adolescents are first discussed, followed by an overall strategy, and priority interventions for health-care providers to attend to specific nutrition needs of adolescents.

4.1 General strategies and intervention models

4.1.1 Integration of health, nutrition and development of adolescents

“Even if health is the major focus of a program, it is still necessary to address the needs of youth to earn money, help their family or learn how to deal with its difficulties, and feel confident in their abilities, or these things may get in the way of youth being able to follow appropriate health regimens. Youth behavior does not occur in a vacuum, and it cannot be fixed in a vacuum. It occurs in the context of the youth’s family and family dynamics, peer group, and neighborhood and social opportunities” (Burt 1996).

As for any other age group, and perhaps even more so, interventions using an integrated approach for the development of the whole adolescent are required. The most effective and sustainable health programmes reportedly offer a variety of services, including counselling, family-life education, training in life and job skills, as well as physical examinations, treatment of diagnosed conditions, and contraceptive services (Kurz and Johnson-Welch, 1994).

Comprehensive programmes directed at multiple-risk behaviours are more likely to be successful than those targeting single specific behaviours, as concluded from studies on adolescents’ risk behaviours in general or related to health (Jessor 1991; Milligan et al, 1997). It is widely recognized that eating and other lifestyle behaviours are oftentimes associated (see Chapter 3).

There is mounting evidence in developed countries that programmes targeting youth are not effective when they are too short, single focused, too late, and when they stress negative behaviours to avoid, rather than promoting positive behaviours, whereas others, school-based or community-based, most probably had positive outcomes because of the holistic approach (Barker and Fuentes, 1995; Burt 1996). There is also evidence of strong support for this integrated approach at the international level (WHO/UNFPA/UNICEF, 1995).

The holistic or integrated approach does not mean that one given project should attempt to do it all, but rather, that programmes addressing different needs and providing different skills and knowledge are forming networks that enable them to meet the multiple needs of youth in a flexible and efficient manner. This is particularly relevant for nutrition, since it is at the crossroads of many sectors (see 4.3).

The common adolescent health agenda of WHO, UNFPA and UNICEF (WHO 1997a) provides a useful framework for integrated and successful programmes, which should be designed to: 1) provide accurate knowledge; 2) build skills; 3) provide counselling; 4) improve access to health services; and 5) create safe and supportive environments. The challenges, guiding concepts, intervention settings, key players and keys to success are mapped. At the centre of the model, promotion, prevention and response to problems and needs are in interaction, under ‘Programming’. Anaemia, obesity and dental caries are the

identified nutrition-related key health problems, along with reproductive health, infection, cancer, violence, accidents, and disabilities. This framework is well adapted to country programming for adolescent nutrition, as long as improving access to food is emphasized as part of the supportive environment whatever the setting, and provided some context-specific adaptations are made. For instance, conditions other than dental caries may represent more critical adolescent nutritional issues in several locations, notably multiple micronutrient deficiencies owing in part to diets of poor nutritional quality and severe malnutrition, particularly in emergency situations (or secondary to diseases such as HIV/AIDS).

In order to devise coherent nutrition strategies, we need to prioritize, but we also need to be integrative and effective in addressing malnutrition, micronutrient deficiencies and diet-related chronic diseases (James 1998). Halting the rapid increase of obesity and related chronic diseases in the developing countries should not wait until these become the top causes of death. There is no quick fix or easy solution for obesity and other nutrition-related chronic diseases. Going beyond individual simple solutions, what is needed to address this neglected public health problem is the development of new preventive public health strategies which affect the entire society (WHO 1998a). Behavioural change is the challenge, as healthier eating and more active lifestyles are the solutions¹⁴. No approach can therefore be expected to give spectacular results, very much unlike micronutrient supplementation, for instance. This may explain why decision-makers and donors are not eager to address these problems. Adolescence is a timely life-cycle period to promote behavioural changes in line with healthy lifestyle and eating. This has to go hand-in-hand with interventions to reduce maternal malnutrition and low birth weights (and adolescent girls are the key target group), as there is growing evidence that foetal malnutrition increases the risks of cardiovascular disease in adult life (Barker 1994; 1996). It should also be emphasized that direct research efforts are crucial to understand barriers to behavioural change better, and to assess better the efficacy and effectiveness of nutrition interventions (Story 1997).

4.1.2 Participation, but confidential health services, crucial in adolescents

With adolescents perhaps more than with any other group, using participatory approaches is critical to education impact. WHO (1993) made recommendations to promote effective youth participation in health-care programmes. A participatory research scheme (narrative research method), and a participatory planning tool (action planning matrix) were also developed by WHO in collaboration with youth. It is our view that the narrative research method would be highly appropriate to document better adolescents' eating behaviours and determinants in developing countries. The latter tool is in many ways similar to the triple-A strategy developed by UNICEF (1990), except perhaps that it puts more emphasis on analysing present programmes to identify actions to fill the gaps between problems and existing responses.

There are documented examples of participatory approaches with adolescents in nutrition, particularly school-based nutrition education programmes, but mostly in developed countries (Delisle, Mavrikakis and Strychar, 1996; James, Rienzo and Frazee, 1997).

A non-directive, and therefore participatory, approach to counselling, which helps make rather than dictates choices, has been adopted by WHO (1993) in its programme for adolescent health. This form of counselling helps adolescents elucidate their opinions and feelings, and make sound decisions, thereby contributing to their development.

While adolescents' participation is key to success, confidentiality is essential when dealing with personal health issues. It is likely critical anywhere, as adolescents strive for independence and autonomy in many areas, although its importance is primarily documented in developed countries (Cheng et al, 1993). The concern of adolescents for privacy in seeking health advice on sensitive issues such as contraception,

¹⁴ Changes in the food industry are also needed so that commercially processed foods contain less saturated fat, but these changes will be consumer-driven.

weight control, sexually transmitted diseases, nutrition, depression, etc., is likely universal. Among United States high school students, 58% had health concerns that they would not want their parents to discover, and 25% would not go for health care because their parents might find out (Cheng et al, 1993). The Society for Adolescent Medicine (1997) has indeed repeatedly affirmed that private and confidential health services are essential for adolescents.

4.1.3 Life skills, health promotion and other intervention models for adolescents

Many psychosociological or environmental models have been developed to explain health-related problems and behaviours, and have served as bases for preventive health strategies. Some have proved well adapted for adolescents. A crucial element for more effective strategies is an understanding of how young people themselves view health and health-related issues, with considerations of the various levels of influences, from the broad cultural values through peers' health beliefs to family interactions (Schucksmith and Hendry, 1998). Social Cognitive Theory (Bandura 1986), the Health Belief Model, as applied to adolescents' nutrition education (Contento, Manning and Shannon, 1992), the theory of planned behaviour (Ajzen and Madden, 1991), and the concept of Health Locus of Control (Schlenk and Hart, 1984; Houts and Warland, 1989) are among the most commonly used. According to the health belief model, behavioural change occurs when one is convinced of the risk associated with the present behaviour, of the possibility to overcome the obstacles to behavioural change, and of the resulting improved health or reduced health risk. According to the social cognitive theory, a high level of self-efficacy is needed in order to change behaviour. Self-efficacy is enhanced by knowledge, practical skills and social reinforcement. The theory of planned behaviour is an attempt to assess the relationship between attitudes and behaviour. It postulates that behaviour is a function of behavioural intention, which in turn depends upon three main sets of variables: attitudes towards performing the behaviour; social pressure; and for behaviours which are not under full volitional control, perceptions of control over performing the behaviour. It has been applied to understanding food choice in adolescents (Dennison and Shepherd, 1995). Attitudes and perceived control accounted for the largest part of the variance of food choice intentions. Health consciousness (self-identity) and peers' behaviour (as perceived social pressure) were also significant determinants. The concept of health locus of control associates health-related behaviours with tendencies for people to be self-determined (inner locus of control), or to be controlled from outside, be it by significant others, fate, etc. Although an inner locus of control was positively associated with nutrition-related behaviours in a group of American women (Houts and Warland, 1989), it is not invariably related to healthier behaviours (Visser 1986). The locus of health control will, however, have implications for health-care and education strategies, as shown in the case of diabetes (Schlenk and Hart, 1984). Another education model applied in health and nutrition is the stage-of-change model (Glanz et al, 1994). Five stages of change are identified: 1) precontemplation, where no change is considered; 2) contemplation, with evaluation of cost and benefit of change; 3) preparation, with measures to change in the near future; 4) implementation of planned change; and 5) consolidation of the new behaviour. The health education and promotion planning tools of Green et al (1980; 1999), commonly referred to as PRECEDE and PROCEDE models, have frequently been used with adolescents. Using a diagnostic approach before planning the intervention, behavioural determinants of a given problem are first identified and isolated from environmental causes. Predisposing, facilitating and reinforcing factors of current behaviours, and of changes to promote, are then highlighted.

It is frequently assumed that young people may not see disease as a major threat, so that their perception of health and well-being may be different from that of adults, with obvious implications for intervention. The 'Life Events' approach has been used to examine adolescents' perception of their well-being, and to assess the importance that they give to physical health problems, relative to other events of their daily life (Cordonnier 1995). It was found that for adolescents, psychosocial dimensions of well-being are much more important than physical aspects. Well-being was perceived as strongly dependent upon external events of daily life. Being well then meant either being independent from external factors, or not being confronted with negative external events. Well-being has a strong connotation of a "space of power". Interestingly, events regarding physical health were the least important; for the adolescents of the study, the most important were those that affect their psychological and interpersonal well-being. Surprisingly, they do not perceive direct links between physical and psychosocial well-being, contrary to

assumptions of most health prevention models. Another important finding in terms of implications for health education is that events that affect their psychosocial well-being trigger a reassessment of opinions and attitudes, but not those that are primarily related to physical health. Health education strategies focussing on health risks are therefore unlikely to be effective in adolescents. Adolescents also perceived that they had less control over health problems than other events. They also regarded such problems as isolated events, without causal relationship with previous events. These observations suggest that it may be difficult to motivate adolescents to change their behaviours for health reasons. Their present health problems are perceived as negligible or easily reversible and beyond their control, and future health risks are beyond their time perspective. Adolescents' particular notion of the future has been underlined elsewhere (Greene 1986). Presenting preventive action itself as a life event may be a useful strategy, or else, connecting it with highly significant life events for adolescents. Short-term incentives (fun, friends, relaxation) are stronger motivators than long-term disease prevention, for healthy behaviours such as physical activity. Thus, as already applied in many instances, the importance to emphasize short-term benefits of healthy behaviours in terms of general well-being, and insist on their empowering effect, which is not as common an argument; responsibility and fear are more frequent arguments, for instance, in the health-belief model. There may be cultural differences, however, and it has been suggested to develop culture-specific tools for assessment of adolescents' well-being, using a participatory approach, as part of empowering health promotion strategies (Joliot and Deschamps, 1997).

Empowerment is a central element of the health promotion paradigm as defined in the Ottawa Charter (WHO 1986b). Empowerment is about increasing control over determinants of health. In young people, increasing control is essentially increasing autonomy, independence and self-determination (Nutbeam 1997). Health promotion should include not only actions to strengthen skills and capabilities, but also actions to alleviate the impact on young people's health of social and economic conditions, and of the physical environment.

The Life Skills Intervention model has been proposed as an approach of choice for addressing adolescents' problems (Wodarski, Smokowski and Feit, 1996), inasmuch as problems that are amenable to change are under individual control. The intervention goal is skill-building to strengthen adolescents' resistance to harmful influences in advance of their impact.

While social marketing is not as empowering and participatory as the intervention approaches mentioned so far, and although it is controversial (Andrien 1994; Montazeri 1997), it has to be recognized that it has a good track record as a strategy of behavioural change, in nutrition as in other health-related matters (Kotler and Roberto, 1989; Novelli 1990; Samuels 1993). Social marketing makes use of commercial tools to identify the problems, to get to know the target audience, its needs and wants, to find with the audience practical solutions to the problem, and to develop, test and evaluate the impact of the messages (Hosmer, Dwyer and Villaroel, 1998). It stresses the fact that the audience target-group members are consumers, clients, rather than inferior beings that need to be educated. In nutrition, much knowledge on the efficacy of the approach has been gained through programmes promoting breastfeeding, weaning foods, and consumption of vitamin A-containing foods (McKee 1992; Smitasiri et al, 1993; FAO 1994; Delisle 1996; de Pee et al, 1998a). Our contention is that social marketing or communication with particular emphasis on the media is likely very effective for promoting good nutrition (and other health-related behaviours) among adolescents, provided we have clear and simple pre-tested messages to convey. Adolescents enjoy the media, they are innovative, and they are a preferred target for commercial advertising (see Chapter 3). Among Australian adolescents, for example, television was an important source of information on food and nutrition, along with parents and schools (Nowak and Speare 1996). Furthermore, adolescents who are not in school or at work are more readily reached by the media.

Perceived communicator similarity was shown to be a critical factor in adolescent education, notably in nutrition education (Doyle and Feldman, 1994). This observation in the USA is reportedly consistent with prior findings both in the USA and in Kenya. Indeed, it was observed that perceived communicator similarity had a significant influence on food attitudes and behaviours, whereas the level of perceived expertise had no effect. Therefore, training local nutrition educators appears more cost-effective than

resorting to nutrition experts (however, we would want the local educators to be well trained). Although its universal application needs confirmation, it would appear that communicator similarity is an essential component of cross-cultural adolescent nutrition education. These findings are consistent with previous experiments showing that peer-led programmes for youth alcohol education were more effective than teacher-led programmes in various settings (Perry and Grant, 1988).

A mix of approaches and models may ensure better results than a narrow approach, as suggested, in view of the complexity and long-term horizon of behavioural change through health promotion, and on the lack of evidence of superiority of any one model (Beerling 1999). In a Cameroon project of school health clubs throughout the country, for instance, emphasis was put on determinants of behaviour in order to raise self-efficacy and life skills of the individuals (Chendi 1998). Those determinants are, among others, peer pressure, media influence, self-confidence, decision-making, social integration, stress management and communication training. Personal skill training was combined with health information, and with other interventions aimed at social and environmental factors affecting adolescent health and development. Training was active and methods included work in small groups, brainstorming, role playing, discussion, etc. The project also included a media component, based on the recognition of the important role of media on adolescents' behaviour and practices. Upon evaluation of this project, it was recommended to extend the approach to primary schools in order to reach the youth before they leave school.

4.2 Programmatic approaches targeting adolescents

School-based programmes are by far the most documented type of programmes for health promotion/education directed at children and adolescents. Given a large body of experience and scientific evidence, it may be said that such programmes yield positive results and outcomes when they are adequately designed and implemented.

4.2.1 School-based programmes

Generally, schools are considered as one of the most significant social institutions where the development of knowledge and skills which promote health and prevent diseases can be addressed (Elders 1993). It also provides a wealth of opportunities to improve nutrition: formal learning, gardening, cooking, and feeding, not to mention interaction with parents and other community members. Success stories are many and diverse, although they are not publicized enough. While they usually do not target adolescents specifically, they represent an effective strategy of reaching those adolescents who are in school. The coverage of educational systems is larger than the health system for school-age populations, at least in the urban population, which represents roughly 70% of the total in Latin America (Pradilla, personal communication). Furthermore, programmes such as school feeding may encourage adolescents to remain in school. This is particularly important for girls. It is known that women's education is a major determinant of their children's nutritional status, provided there is a minimum level of resources (Reed, Habicht and Niameogo, 1996).

4.2.1.1 Overview of policies and programmes

Many UN agencies are active on the school front for health and nutrition (Bundy et al, 1998), among which UNICEF, with a school health and nutrition strategy, UNDP, co-sponsor of 'Partnership for Child Development' created in 1992, and WHO, which launched a Global School Health Initiative in 1996. UNFPA supports reproductive health programmes for adolescents. UNESCO supports educational initiatives and provides technical support for WFP school feeding activities. FAO is developing school-based education to promote dietary diversification and food security. The World Bank, in its 1993 Report, identified school health and nutrition programmes as one of the five priority public health initiatives. It supports programmes delivering simple health and nutrition intervention packages. Many development banks, bilateral agencies and NGOs are also involved.

The Partnership for Child Development (PCD) was established to conduct and promote operations research on school health and nutrition programmes (Hall and Bundy, 1998). There are currently PCD programmes in 14 countries. The experience has confirmed the practical benefits of school-based programmes, and has led to such conclusions that: 1) Deworming and periodic micronutrient distribution can be done through schools, and they have an impact; 2) Teachers may provide some health care to children, after minimal training, and this role is well perceived by them, children and parents; 3) Health programmes can be implemented in schools at low cost, because they make use of an existing infrastructure. Baseline studies also revealed that schoolchildren experienced much more malnutrition and ill-health than previously assumed (Hall and Bundy, 1998). Ongoing research is looking, among other things, into the impact of iron and vitamin A supplementation, coupled or not with anthelmintics, on nutritional and micronutrient status of children.

The WHO Global School Health Initiative (1996a) is a concerted effort by international organizations to help schools improve the health of students, staff, parents and communities. A “health promoting school” can be characterized as a school constantly strengthening its capacity as a healthy setting for living, learning and working (WHO 1998b). More specifically, it:

- Fosters health and learning with all the measures at its disposal;
- Engages health and education officials, teachers, students, parents and community leaders in efforts to promote health;
- Strives to provide a healthy environment, school health education, and school health services along with school/community projects and outreach, health promotion programmes for staff, nutrition and food safety programmes, opportunities for physical education and recreation, and programmes for counselling, social support and mental health promotion;
- Implements policies, practices and other measures that respect an individual’s self-esteem, provides multiple opportunities for success, and acknowledges good efforts and intentions as well as personal achievements;
- Strives to improve the health of school personnel, families and community members as well as students; and works with community leaders to help them understand how the community contributes to health and education.

Strengthening interventions to reduce helminth infections was conceived as an entry point for the development of health-promoting schools (WHO 1997c), as they markedly contribute to improving nutritional status of schoolchildren. Indeed, hookworm infection contributes to iron deficiency and anaemia. Roundworm infections may alter vitamin A status by affecting utilization of provitamin A carotenoids (Friss et al, 1997). More generally, parasites contribute to ill health and malnutrition. Results are beginning to show in terms of improved growth (Hall and Bundy, 1998). WHO (1997c) now recommends that in areas where the prevalence of mild-moderate underweight in children is greater than 25% and where parasites are known to be widespread, high priority be given to deworming programmes. The programme may also integrate micronutrient supplementation and nutrition education for food-based interventions to prevent micronutrient malnutrition. Prevention of food-borne parasitic infections should also be integrated, through education of students, rules for school feeding programmes, providing water and hand-washing facilities for students and canteen personnel, training food handlers, and encouraging the students to communicate the food safety message to parents and other children. In nutrition more specifically, the health-promoting school should aim at (WHO, 1998b):

- Gaining the full health and educational potential of food and nutrition sources for students and other members of the school, family and community;
- Applying the school’s full organizational potential to improve the nutritional status of students, staff, families and community members;
- Laying a foundation of lifelong healthy eating based on favourable experiences, sufficient skills and confidence in one’s capacity to practise a healthy lifestyle.

Establishing healthy eating habits at a young age is critical, and schools have an important role to play in this regard, a role that is acknowledged worldwide. In the USA, school-based nutrition programmes are

regarded as highly important today, as children and adolescents frequently decide what to eat without adult supervision (Guidelines for school health, 1997). Schools can reach almost all children and adolescents, they provide opportunities to practise healthy eating, they can teach students to resist social pressures, skilled personnel are available (teachers), and evaluations suggest that school-based nutrition education can improve the eating habits of young persons (Contento et al, 1992; 1995). Furthermore, school nutrition interventions were found to have a positive effect on students' health, school performance and school attendance, which provides compelling arguments for universal nutrition programmes and services in schools (Center on Hunger, Poverty and Nutrition Policy, 1994; Kalina, Philipps and Minns, 1989; Meyer et al, 1989).

The Centers for Disease Control and Prevention (CDC 1996) has developed, with partnering agencies, a series of guidelines for school health programmes to promote lifelong healthy eating. The following recommendations are made, which may also apply elsewhere. They also converge with those of the WHO's Global School Health Initiative:

- Adopt a coordinated school nutrition policy that promotes healthy eating through classroom lessons and a supportive class environment.
- Implement nutrition education from preschool through secondary school as part of a sequential, comprehensive school health education curriculum designed to help students adopt healthy eating behaviours.
- Provide nutrition education through developmentally appropriate, culturally relevant, fun, participatory activities that involve social learning strategies.
- Coordinate school food service with nutrition education and with other components of the comprehensive school health programme to reinforce messages on healthy eating.
- Provide staff involved in nutrition education with adequate pre-service and ongoing in-service training that focuses on teaching strategies for behavioural change.
- Involve family members and the community in supporting and reinforcing nutrition education.
- Regularly evaluate the effectiveness of the school health programme in promoting healthy eating, and change the programme as appropriate to increase its effectiveness.

Selected school-based strategies are graded according to age of schoolchildren, and focus on making the food environment more health-enhancing, on enhancing personal characteristics that will support healthy eating, and on enhancing behavioural capabilities that will support healthy eating.

The American Dietetic Association (ADA), the Society for Nutrition Education, and the American School Food Service Association jointly issued a position statement in 1995 (ADA Reports). The position is that comprehensive school-based nutrition programmes and services be provided to all the nation's [USA] elementary and secondary students. These programmes and services include: effective education in food and nutrition; a school environment that provides opportunity and reinforcement for healthy eating and physical activity; involvement of parents and the community; and screening, counselling and referral for nutrition problems as part of school health services. Teaching methods based on the social learning theory have been advocated for school-based nutrition education. Three sets of factors that influence diet are identified: individual (personal characteristics such as knowledge, personal values, expectations, self-efficacy), environmental factors, which support, permit, encourage or discourage certain eating behaviours (including presence of influential role models; social norms; social support; the opportunity to engage in certain eating behaviours); and behavioural factors, which are the skills, intentions and reinforcements necessary for healthy eating (ADA Reports 1995).

4.2.1.2 Examples of effective school-based nutrition programmes

Despite all the attention given to schools as a solution to the problem of poor health behaviours of young people, evidence of effectiveness of school programmes is still little documented, according to some (Nutbeam 1997). There may not be enough curriculum time to address all relevant health issues, which then compete with each other: smoking; alcohol and illicit drug use; AIDS and sex education; nutrition; etc. School-based nutrition education may be effective when well done, but weaknesses are

often reported, and in most instances, quality control is not regarded as an issue. In Brazil, for instance, it was found that nutrition education was usually given by science teachers at the secondary level, and that these trainers were not well-trained or lacked interest in health subjects (Marcondes 1984).

A few examples of successful school-based nutrition activities or programmes are given below. Several case studies may be found elsewhere (WHO/UNESCO/UNICEF 1992). Success may refer only to implementation, or it may also refer to outcomes.

Curriculum integration is an interesting means of addressing nutrition. Curriculum integration is a mechanism for helping children view school content outside of presupposed academic boundaries. It brings together two or more disciplines for the purpose of making one curriculum which reflects the qualities of all the disciplines and gives maximum benefit to the learner from experiencing such a curriculum. It provides a framework for children to apply knowledge from several disciplines and to use this knowledge to solve real-life problems. It also reflects interaction among persons and an understanding of their way of thinking about themselves and the world in which they live. Nutrition and mathematics form a natural partnership and can be integrated, as shown in the USA (James and Adams, 1998). Nutrition science incorporates many mathematical concepts and procedures such as statistics and probability; fractions and whole numbers (concepts and operations); measurement, and numeration.

The 'Bienestar Health Program' (Trevino et al, 1998) is an interesting school-based pilot programme for diabetes risk-factor prevention, targeted at 4th grade Mexican American children in San Antonio (Texas). The primary goal is to decrease two risk factors: obesity and dietary fats. The programme is based on the Social Learning Theory, on social systems structure, and on culturally relevant material. Learning activities were developed for four social systems that potentially influence the child's behaviour: parents, classroom, cafeteria, and after-school care. Preliminary results show that diabetes health knowledge has increased, that dietary fat significantly decreased, and that the number of fruit and vegetable servings increased. We obtained, by and large, similar results in a pilot programme among Native Indian schoolchildren in Quebec designed for the same purpose (Delisle, Mavrikakis and Strychar, 1995).

In Oslo, an integrated health education programme was introduced in schools for students aged 10-15 years in the early 80s, and the evaluation involved comparison with control schools (in WHO, 1993). The focus was nutrition, tobacco, alcohol and physical activity. Positive results were shown: fewer students started smoking, particularly among the younger ones. Food habits improved in programme-schools (less butter, more bread, skim-milk). Physical activity increased in boys and in girls, and there was less weight gain in the programme-schools. Blood cholesterol increased less in boys and girls of programme-schools.

In the school component (6th to 12th grade) of the Minnesota Heart Health Program, which is designed to reduce cardiovascular disease in three intervention communities of North-central USA, the stability of outcomes and gender differences were analyzed (Kelder et al, 1995). The classroom intervention programmes included, in addition to alcohol, smoking, and physical activity components, some components on healthy eating. Several theoretical models guided the intervention design: changing peer norms, providing alternative healthy role models, increasing social skills to enable the students to resist peer pressure to engage in health-compromising behaviours, and generating health-enhancing alternatives. All programmes relied on peer leaders of the same age trained by their schoolmates, trained by community staff, and who conveyed new information, norms, skills to the students. Outcome evaluation was based on self-administered questionnaires over a 6-year period. The measure for dietary intake was self-reported preferences. Females reported healthier food choices than males at nearly all follow-ups. Food choices improved steadily, but the results gave evidence of early consolidation and tracking of food preference behaviours, as baseline rank categories remained the same over time, and evolved in a parallel fashion. The early consolidation of health behaviours suggests that interventions should begin early, prior to 6th grade (around 12 years of age) based on this study. One explanation for the gender difference could be that early on, many girls adopt a dieting behaviour for weight control, with the selection of low-fat foods. It may also be that girls are more receptive to the group-oriented, open-discussion format of the social influences model of intervention.

Increasing fruit and vegetable consumption as a means of increasing fibre and antioxidant intake for chronic disease prevention is an important aspect of dietary guidelines for Americans, and nationwide and school-based programmes aim at increasing fruit and vegetable consumption (Nicklas et al, 1997). In New Orleans, intervention (and control) schools were followed for three years, from 9th to 12th grade. This programme provides a model to show that it is possible to modify dietary habits of highschool students through positive media messages relative to that age group, increased exposure to targeted foods, and minimal classroom activity. The programme, which also included parental support, was designed to create an environment in which predisposing, enabling and reinforcing factors would positively influence fruit and vegetable consumption, on the basis of the PRECEDE model (Green et al, 1980).

Pursuing the same objective, that of increasing fruit and vegetable consumption, a school-based intervention is described in which groups of friends who regularly eat together are encouraged to set their own goals in this regard, and to decrease their intake of chips (Shepherd and Dennison, 1996). The accent is on using peers as a source of support for healthy eating, and on making sure that there is an adequate supply of fruit and vegetables within the canteen.

School gardens may make a substantive contribution to eating patterns and nutrition among schoolchildren, and in families at large. In Ecuador, for instance (Chauliac et al, 1996), school gardens were part of the strategy to introduce more fruit and vegetables into local diets, as a means of food diversification and food security in terms of nutritional quality. The programme pursued objectives of knowledge, attitudes and behaviours, and skill development: 1) to learn about the importance of diversifying the diet, and the role of fruit and vegetables; 2) to learn how to grow vegetables and to do it; 3) to use school breakfasts as an opportunity to eat the vegetables grown; and 4) to use the gardening experience to promote cooperation, responsibility, self-esteem, self-confidence, motivation, and the work ethic. The evaluation compared changes in knowledge, practical skills and behaviour over a school year, compared with control schoolchildren. The school-garden intervention had a positive impact on the children at all three levels. In addition, it associated vegetable-eating with satisfaction of consuming the fruit of one's labour, which was a source of interest and motivation. A bottom-up educational strategy was used, with the schoolchildren conveying the information to their families as a means of sensitizing them to integrate the innovations learned by their children in school. It is not possible to isolate the specific effect of the school garden from other intervention components, although many children were asked to replicate at home their gardening experience in school. This is an example of multisectoral or integrated projects that cannot be fully evaluated in terms of their specific impact, but that can be assessed for the process, and that show successful implementation. Considering only the net outcome resulting in a short time-span from a specific project component is not only difficult with nutrition promotion or education which is usually multi-pronged, it also underestimates the real outcomes and benefits.

Schools are usually part of the community, and school health and nutrition initiatives should involve the community. This is the case for the school-snack programme in Indonesia, where snack menus, purchases, and preparation are done at community level, and must make use of locally produced foods (Studdert and Soekirman, 1998).

School-based programmes reach primarily those adolescents who are enrolled, and it may be a concern that those not in school are the most in need. However, school feeding programmes can motivate children, in particular adolescents, to attend school, which would be a positive effect for girls in particular. This is in accordance with the recommended emphasis on girls' education for improving health (World Bank 1993). Furthermore, while not attending school, some adolescents may be attracted to participate in school-based health and nutrition promotion programmes, and for this purpose, community outreach activities may be considered for those who have left school. Actually, this is done in some child-to-child initiatives (see below). For adolescents, particularly if they cannot be reached through schools, alternative environmental strategies have to be developed.

Whilst school-based health programmes are critically important, the school cannot solve all health and social problems (Nutbeam 1997). Schools may produce well informed youth with skills to manage their life and their health, but they may not be able to live accordingly for reasons beyond their control. Empowering young people should not convey the message that the solution of their problems is essentially within themselves. Supportive environments are crucial, with opportunities to overcome economic or social disadvantages, food security as a prerequisite for adequate nutrition, and relevant health policies, services, and community-based programmes.

4.2.2 Child-to-child, youth groups, and other community-based programmes

Programmes intended for adolescents outside the school system are still little documented. Even child-to-child schemes are often school-based. Yet, such programmes may be highly relevant to reach adolescents, boys and girls, and for integrating health, food and nutrition-related activities. The peer approach is widely used in Latin America for health promotion actions, as already mentioned under section 2.5 (Pommier et al, 1997). It allows to reach not only adolescents, but also younger children as it is oftentimes customary for the older children to take care of the younger ones.

The objective of the child-to-child Trust is to promote and preserve the health of communities worldwide by encouraging and enabling children and young people to play an active and responsible role in their own health and development as well as that of other children and their families (Hall and Bundy, 1998). The child-to-child Trust involves children in health promotion by performing three main functions: 1) designing and distributing health education material; 2) assisting health education workers in designing, implementing and evaluating the approach; and 3) coordinating a worldwide information network for those applying the approach. In Cameroon, based on this approach, a countrywide health project with particular focus on Aids was launched in 1993 for all secondary schools. School health clubs were created in 900 secondary schools as a means of addressing health needs identified with adolescents in baseline assessment (Chendi, 1998). The main activities of health clubs are: 1) training leaders; 2) meetings of circles to address school environment concerns; 3) peer education and empowerment; 4) community work; 5) involvement in national youth week activities; 6) linking with youth having left school, with nurses, teachers, and PTAs; 7) personal growth; 8) training for counselling; 9) family life education; and 10) money-raising activities for the club.

Also in Cameroon, an ambitious youth group project for the promotion of reproductive health was undertaken with active participation of adolescents, in order to address their concerns and problems that are otherwise unattended to (Walla, 1998). This project includes many activities, such as a programme of training on family-living, consisting of informal courses (with a module on food and nutrition in adolescence), a strategy of female adolescents' empowerment, family-planning and reproductive-health activities, and education in population phenomena. This is another example of integration of nutrition in broader programmes based in communities.

There are examples of youth programmes in Central America and the Caribbean having adopted a holistic approach, and notably the *Proyecto Alternativas* in Honduras, which serves working children of the informal sector and their families, as well as street children without a family. It combines educational and social services, community-based health care, food supplementation, and basic health education focusing on priority issues, counselling, and significant levels of youth empowerment and control over the project's planning and decision-making. Another example is *Servol* in Trinidad and Tobago (Barker and Fuentes, 1995; Burt 1996), an employment and training project offering services throughout the country. A life skills component was added to help youth develop the personal abilities they need to function successfully in the society and workplace, including: self-awareness; parenting; nutrition; health and sex education; drug abuse prevention; sports and recreation; basic literacy and social studies; community service; micro-entrepreneurship; employment seeking. Youth must complete the life skills component before receiving formal job training.

Different youth groups may play an active role in promoting health within the group and also in their community: scout movements, theatre groups, and other child-to-child initiatives, such as primary health-

care activities including growth monitoring and promotion (WHO 1993). Health and nutrition programmes at the worksite are one way of reaching adolescents already in the workforce, and this would likely be particularly relevant in cities. Such programmes may also be attractive for employers if they contribute to better productivity. Worksite nutrition programmes may revolve around feeding, for instance improving the nutritional quality of street foods or nutrition promotion in cafeterias, or nutrition education may be a self-standing programme. However, more evaluation data on the effects of worksite nutrition programmes in developing countries are needed (Stuart and Achterberg, 1998).

4.3 Overall strategy for nutrition intervention in adolescence

Nutrition is at the interface of health, agriculture and education¹⁵, and therefore nutritional health, whether in adolescents or in other age groups, usually requires concerted action on several fronts, not only in health. For instance, and this applies in developing as well as developed countries, adequate access to food is a critical determinant of adequate intake and nutritional status, but it lies by and large outside the health domain. Upstream improvements in food systems may be needed, along with income interventions for the poor (Delisle 1998a). Nutrition can also benefit from improvements in personal and environmental health conditions, meaning that health programmes and health care already make a contribution through disease prevention and control, infections in particular. Furthermore, reproductive health activities may have a substantive impact on nutrition of adolescents and of the next generation, through delaying the first pregnancy, adequate antenatal care, and subsequently spacing of pregnancies. Regarding education, it is now established that an effective strategy for delaying the first pregnancy is to keep girls in school, aside from the positive and strong relationship between women's education level and the health and nutrition of their children (Leslie 1995).

While recognizing the need for a multisectoral approach to adolescents' nutrition, the strategy and specific interventions discussed below are primarily directed at health-care providers. Community-based food security initiatives, for instance, are not discussed, in spite of their high relevance for nutritional improvement and for adolescents' involvement, as health is seldom the lead sector. Health workers nonetheless often collaborate, and they are encouraged to do so.

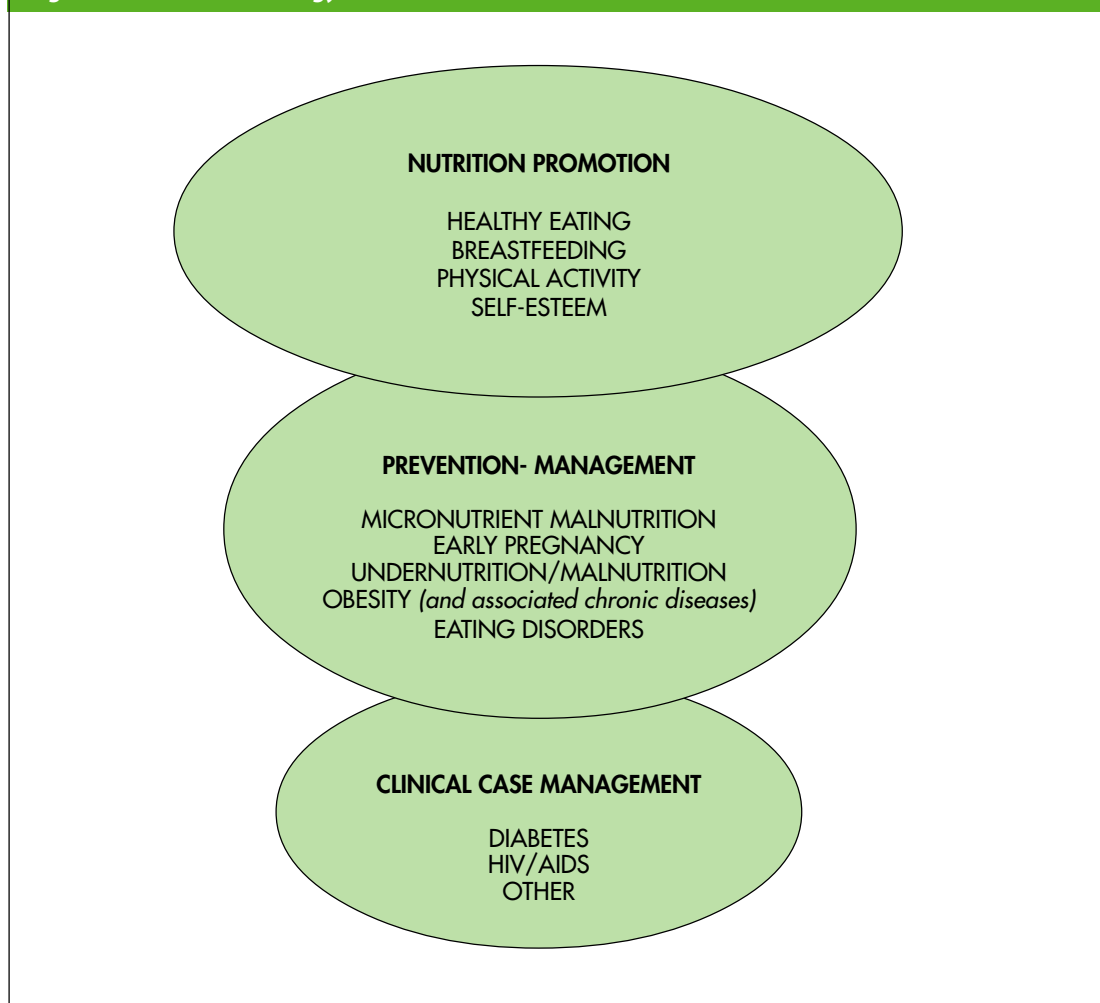
For nutritional health in adolescence, an integrated approach to managing risks and problems is advocated, somewhat similar to integrated management of childhood illness (IMCI) (WHO 1997d). The strategy is directed at both preventive and curative activities, and it involves improvement in case management skills, in health system and family and community practices. Along the same lines, we may strive to improve health-care providers' skills in the detection and case management of nutrition-related problems, analyse the needs of health systems to have more of an effect on nutrition, and link the health facility-based programmes with family- school- and community-based programmes targeting adolescents' nutrition.

Adaptation for adolescents of the nutrition-relevant IMCI interventions for children would lead to suggest an overall strategy with components of promotion, prevention and treatment, as follows (see Fig.2):

- 1) Nutrition promotion: As an integral part of health promotion, it involves the promotion of healthy eating, physical activity and other components of healthy lifestyle, and it should also include promotion of breastfeeding and self-esteem. Promotional activities are to be conducted through the media, and for interpersonal communication, through schools, health facilities, communities and even work-sites;

¹⁵ This may be inferred from the conceptual framework of Fig. 1

Figure 2: An overall strategy for nutrition intervention in adolescence



- 2) Prevention and management of nutritional disorders and risk conditions, which involves, in particular, control of major micronutrient deficiencies, nutritional management of adolescent pregnancy, management of malnutrition in adolescents (plus support to food and income security interventions as preventive means), prevention (and management when needed) of obesity and of eating disorders;
- 3) Clinical nutrition case management, which includes disorders affecting nutrition, in particular dietary treatment and guidance in adolescents with diabetes and with HIV/AIDS or other systemic infections. Other specific conditions that require nutritional management, usually under specialized supervision, and that are not uncommon in adolescents are, among others, food allergies and intolerances, dyslipoproteinemias, etc.

Nutrition interventions or services grouped under promotion, prevention and management, and nutritional treatment of specific conditions, are all part of a global adolescent nutrition strategy. As illustrated (Fig.2), nutrition promotion should receive the most attention, and it should permeate preventive and curative activities alike. This figure is however incomplete, as it does not include policy, advocacy, training, surveillance and research components of the global strategy.

4.4 Nutrition promotion, as part of health promotion

It is usually assumed that health promotion automatically includes, and effectively promotes, good nutrition. However, it may not be so, unless nutrition concerns and objectives are explicit in health promotion programmes. Furthermore, nutrition promotion goes beyond nutrition education, defined as any set of learning experiences designed to facilitate the voluntary adoption of eating and other nutrition-related behaviours conducive to health and well-being (Bedworth and Bedworth, 1992). Nutrition itself is a determinant or a specific aspect of health. Promoting adequate nutrition with adolescents, according to the health promotion strategy, also means enhancing control of adolescents over their food and food resources (food security), and improving their access to appropriate nutrition services, in addition to strengthening food-related skills and encouraging healthy eating and lifestyle. This should be a priority action of the health sector for adolescent nutrition everywhere, as a means of preventing dietary inadequacies as well as of reducing the risk of developing chronic disease in later life. It is a long-term approach and a difficult endeavour, however, which is a major deterrent, but it is indubitably the nexus of nutritional improvement.

As one dimension of the broad health promotion approach, nutrition promotion action of health-care providers with adolescents should pursue the following objectives:

- To encourage healthy eating and physical activity (as part of a healthy lifestyle) presently and in future.
- To develop positive attitudes towards breastfeeding.
- To strengthen self-esteem as a means of resisting adverse environmental influences on dietary practices.

In its recent guidelines regarding nutrition in adolescent girls, Health Canada (1999) advocates the promotion of the ‘Vitality’ approach, which integrates healthy eating, active living, and positive self-esteem, away from regimented dieting and exercise programmes. However, promotion of breastfeeding is unfortunately not spelled out.

Adolescence is an appropriate time to develop positive attitudes of young women (and others) vis-à-vis breastfeeding, if not sooner. In Korea for instance, where only 25% of women breastfed in the early 1990s and where middle-class highly educated women were the ones not to breastfeed, a breastfeeding campaign using a video presentation and panel discussions among female adolescent students was assessed for its impact on their attitudes and intentions (Kim 1998). It was found that exposed adolescent girls have significantly higher scores on attitudes towards breastfeeding and on intention to breastfeed. There was no difference, however, in one aspect of attitudes - “keeping good body figure”, which suggests that in weight-conscious cultures, it is important to destroy the myth that breastfeeding ruins the figure. Similar positive effects on female adolescents’ attitudes were reported by Friel et al (1989) in Canada as a result of a television advertisement promoting breastfeeding.

Inducing sustainable behavioural changes is a challenge in itself; it is even more so among adolescents for several reasons, including their limited concern for long-term health. Factors that determine positive changes in eating behaviours in the light of lessons learned have been summarized (Smith 1998).

For promoting healthful nutrition practices in adolescents, the challenge is to develop interventions that succeed in increasing motivation, while decreasing barriers to eating a healthful diet and being physically active (Neumark-Sztainer et al, 1998). Interventions have to be culturally appropriate. Adolescents of low SES should be focused as a priority group: in the Minnesota Adolescent Health Survey at least, they often had less adequate eating patterns and were more overweight (Neumark-Sztainer et al, *ibid*).

Many approaches have been developed and utilized in order to bring about behavioural change (section 4.1). In addition to the approach or format, the content or message(s) to convey is a difficult issue that tends to be overlooked. Food-based dietary guidelines are most useful tools in this regard for promoting

Nutrition education factors associated with positive dietary changes (Smith 1998)

- Active participation
- Appropriate and convenient sites
- Stage approach to behaviour change
- Realistic objectives
- Specific information on advocated changes and how to achieve them
- Delivery of same message from different sources
- Utilization of social and community networks
- Information that allows reasoned choice
- Association of desirable behaviour with self-satisfaction and reward
- Problem-solving approach
- Strengthening self-efficacy.

nutrition among the population. One of the recommendations of the International Conference on Nutrition (FAO/WHO 1992) for improving eating habits and nutrition was indeed the preparation of guidelines that take into account cultural patterns and context situations in each country. For there is more than one dietary pattern that is consistent with health. WHO and FAO convened an international expert consultation on this issue in 1995 (WHO 1996b) and recently issued recommendations for developing such guidelines (WHO 1999b). Based on current scientific knowledge on nutritional requirements and on the types of diet-related diseases that are prevalent in a given population, dietary guidelines express the principles of good dietary practices (Latham 1997). Food-based dietary guidelines translate into terms of type and amounts of food to eat, nutritional requirements and dietary recommendations for health. These guidelines are not only intended to prevent deficiencies, but also for optimal health and prevention of chronic diseases. They are designed for the public, and they are also widely used by health and nutrition professionals for counselling and education purposes. Dietary guidelines may also facilitate assessment of dietary quality. The 'Healthy Eating Index' developed in the USA (USDA 1995), for example, is used as a single summary measure of dietary quality, based on 10 guideline components. The target group of dietary guidelines is in general the whole population, with specific recommendations for defined physiological groups. Although the main focus is food, guidelines may also include messages on physical activity. Breastfeeding messages could also be included, although the guidelines usually target families and family members above two years of age. General dietary guidelines normally apply to adolescents, whose high requirements for growth are usually underlined therein. Specific applications of the guidelines in this age group are available, for instance, in Australia (National Health and Medical Research Council, 1995).

Dietary guidelines have been in existence for a long time in many developed countries, and are periodically updated. When they were evaluated, they proved effective in reaching the target population with relevant advice for healthy eating. More evaluation work is required, with a focus both on the process of developing and implementing the guidelines, and on its impact. Culturally-relevant sets of guidelines may be developed for specific groups within the population, as is being done, for instance for some Amerindian groups in Canada (Mercille and Delisle, 1999). Guidelines are best developed by a multidisciplinary team with participation of the various sectors involved, including consumer groups (WHO 1999b).

FAO (1997) has produced a set of nutrition education materials (*Get the best from your food*) that may be helpful in developing food-based dietary guidelines. Four fundamental messages are suggested for positive dietary guidance:

- 1) Enjoy a variety of food, recognizing the importance of dietary diversity for dietary adequacy and for pleasurable eating;

- 2) Eat to meet your needs, which emphasizes the changing needs throughout the life cycle, and the importance of a balanced diet;
- 3) Protect the quality and safety of your food, one aspect of nutrition which is oftentimes overlooked;
- 4) Keep active and stay fit, which shows that nutritional health is not only a matter of food.

In the framework of health promotion, the Pan American Health Organization (PAHO 1997) and the Institute of Nutrition of Central America and Panama (INCAP) also recognized the importance of preparation and implementation of food-based dietary guidelines as one priority strategy to promote healthy behaviours and practices, and consolidate the culture of health. Subregional workshops were held to promote and discuss the various stages of the process (Peña and Molina, 1999). After identifying priority nutrition-related problems and risks of the target population, objectives of the Guidelines are formulated, with the aim of addressing the problems and reducing the risks through healthy diets and lifestyles. Preliminary recommendations are then formulated, and their feasibility is tested with the target population. The guidelines are then prepared, tested and validated before they are implemented. In the Latin American Region, seven countries are testing or implementing their set of guidelines, and an additional 13 are at the preparatory or development stage.

There is now ample and compelling scientific evidence that diet is the most crucial factor in the causation of coronary heart disease. A growing body of science suggests that the same dietary factors are also associated with increased risk of other chronic diseases such as some cancers, hypertension, and diabetes (see Chap.3). The most potentially pathogenic dietary factors are saturated and *trans* fatty acids, and not dietary cholesterol. Recent data from a prospective study provide convincing evidence that consumption of up to one egg per day is unlikely to have adverse impact on cardiovascular disease and stroke risk, except perhaps in people with diabetes (Hu et al, 1999). There is general consensus on the importance of limited fat, in particular saturated fat, and of ample consumption of fruits, vegetables, wholegrain cereal and legumes for reducing chronic disease risks. These are generic messages that are applicable anywhere and that only need to be tailored to location-specific food supplies and habits. Protective factors that have been identified are n-3 fatty acids, soluble fibres, saponins, and antioxidants (carotenoids, vitamins E, C). Their precise roles are not yet entirely elucidated and dietary changes other than recommended by most food-based guidelines are not warranted, nor supplements of these substances. It is likely that many more beneficial plant components are yet to be identified.

The present approach of the American Dietetic Association (Connor 1999) is increasingly relevant for prevention in developing countries. It consists of moving away from a dieting mode to promote cultural changes in eating style. The eating style approach or concept consists of achieving desirable changes progressively (meaning more diversified food, new preparation methods, more fruits, vegetables, wholegrains, and legumes), in order to achieve a stable remodelling of eating style, or normal way of eating.

4.5 Prevention and management of nutritional disorders and risk conditions

4.5.1 *Nutritional assessment based on anthropometry and inquiry: Specific issues in adolescence*

Appropriate assessment of nutrition-related problems and risks in adolescents should be a primary responsibility of health-care services, whether for screening, surveillance, programme planning or programme evaluation purposes. This is the rationale for this section on nutritional assessment. It may be assumed that adolescent girls are at higher nutritional risk than boys (see Chapter 3), and particularly so if they are pregnant and primiparous. There is evidence also that younger adolescents are at higher risk than older ones, and for adolescents as for the rest of the population, the poor are likely at increased risk compared to their better-off peers.

Nutritional status assessment using anthropometry is a simple, and yet extremely useful initial approach to adolescent nutrition, along with physical examination if in a clinical setting. A rapid dietary assessment

is also indicated whenever a nutritional problem is suspected, and as a basis for nutrition counselling. Background information on locally common food and nutrition problems, and on food habits in the area is usually available and should be accessed by health-care providers, even if it is unlikely that adolescents will ever be identified as a separate group.

Obviously, additional methods of nutritional assessment are needed beyond anthropometry and dietary enquiry for the 'nutritional examination', for instance to detect specific nutrient deficiencies, iron, vitamin A and iodine in particular. Clinical, biochemical and functional methods that are appropriate to specific needs and settings have been described (Latham 1997). Physical signs of malnutrition and specific micronutrient deficiencies are important to keep in mind, with emphasis on those that are likely of common occurrence in the area. (Anthropometric assessment of pregnant adolescents is further discussed under section 4.5.3.)

4.5.1.1 Nutritional anthropometry

Anthropometric assessment of adolescents is more complex than children's because of the transition in body composition, and of the variable timing of the growth spurt. Although research is ongoing on anthropometric references and cut-off points for body mass index (BMI), it would appear relevant to consider anthropometric assessment of adolescents based on BMI as routine in health care, and perhaps also in school health. Body weight management is seen as a highly relevant means of preventing obesity and eating disturbances in industrialized countries, and it should be the same in developing countries. Anthropometric assessment also allows to detect adolescents exposed to undernutrition, and to screen adolescent girls who will likely be at risk when they are pregnant because of low stature. Obviously, indicators would have to be modulated according to area-specific nutritional problems that are likely to be encountered, but irrespective of this, BMI should be one of the key indicators anywhere, and the two tails of the distribution should be looked at.

Somewhat comparable to growth monitoring and promotion in infants and young children, but less demanding in resources, anthropometric assessment of adolescents should trigger an appraisal of dietary patterns and intake whenever BMI appears too high or too low. This would achieve two-pronged prevention: undernutrition and obesity. A BMI chart such as used in USA adolescents to detect both underweight and overweight (Elster and Kuznets, 1995) could represent a useful tool elsewhere for weight management and prevention.

Including some nutrition indicators on adolescents in nutrition monitoring systems would be a means of pointing to adolescents' nutritional problems. This deserves feasibility research. In the USA, Centers for Disease Control and Prevention (CDC) established in 1990 the 'Youth Risk Behavior Surveillance System' to help monitor progress towards achieving national health and education objectives. Dietary behaviours are one of the six health risk categories. CDC conducts the Youth Risk Behavior Survey biennially in a national probability sample of high-school students. Consumption of fruit and vegetables, consumption of foods high in fat, perceptions of body weight, and attempted weight loss and weight-loss techniques used are the specific dietary attitudes and behaviours monitored.

The report of the WHO Expert Committee for anthropometric methods and reference data (WHO 1995a) includes specific recommendations for appropriate use of anthropometry in all age groups including adolescents, for screening or programme response evaluation, at the individual and at the population level, along with additional factors for interpretation of anthropometric indicators. Reference data tables are provided, as well as nomograms to convert weights and heights into BMI values.

With adolescents, in contrast to under-five children, weights and heights alone are less specific indicators of nutritional status. Anthropometric data may help identify stunting, underweight, overweight and obesity. Stunting, or short height for age, may reflect malnutrition in the past without representing a current problem that can be tackled. The assessment of obesity and adiposity level is more difficult in adolescents than in adults because of rapid changes in body composition. Before puberty, males and

females have similar proportions of fat (15% and 19% respectively), muscle and lean body mass. During puberty, the rate of linear growth increases to reach that of 2 year-old children. In girls, fat increases to 23% at age 20, while it decreases to 12% in boys (Garn and Clark, 1976). The results of a validation study of BMI against other measures of body fat in children and adolescents supports the use of BMI as a measure of adiposity, provided age is taken into account (Pietrobelli et al, 1998). The clinical validity, that is, the association of obesity indices with current or future morbidity and mortality rates, is less well documented in adolescents than in adults, although associations have been observed between BMI and blood pressure, adverse lipoprotein profiles, non-insulin-dependent diabetes, and atherosclerosis (Sangi and Mueller, 1991; Must et al, 1992; Pinhas-Hamiel et al, 1996) (see Chap. 3). More research is awaited to determine BMI cut-off points in children and adolescents that prove sensitive and specific as indicators of obesity and associated morbidity and death risk in adulthood. An expert group is presently looking into the best methods to classify overweight and obesity in childhood (WHO 1998a). For adults, a coherent system for identifying underweight, overweight and obesity based on BMI has been developed and is recommended for international use (WHO 1998a). Underweight is defined as BMI under 18.5 (with severe underweight under 16). The cut-off for overweight is 25; the pre-obese category goes up to 29.9; obesity class I from 30 to 34.9; obesity class II from 35 up to 39.9; and obesity class III from 40 up. However, this system does not apply as such to adolescents.

The following specific WHO recommendations for adolescent anthropometry (WHO 1995a; de Onis and Habicht, 1997), with primary focus on public health settings, still hold:

- The appropriate stunting indicator is the 3rd percentile (or Z-score of 2 below the median) of height-for-age, using the NCHS/WHO data as reference population;
- The appropriate thinness indicator is the 5th percentile cut-off of BMI-for-age, using data from Must et al (1991), pertaining to the same population of NCHS;
- Maturational indicators are needed in addition to anthropometry, for there are differences in timing of growth spurt. Bone age is a measure of skeletal maturation, but it is not easily assessed in field settings. More practical indicators are in girls, median age of menarche and in boys, median age of attainment of adult voice, which both occur roughly one year after peak height growth velocity. When population estimates of maturational status are available, age-specific means or medians for anthropometry may be adjusted for different rates of maturation from the reference population (de Onis and Habicht, 1997);
- For defining obesity, the 85th percentile of NCHS reference BMI data-for-age is recommended as cut-off (or value of 30 and above), combined if possible with skinfold thickness, particularly for individual assessment. For subscapular and triceps skinfolds, the reference data are also taken from the NCHS population, and the suggested cut-off is the 90th percentile. High BMI alone is interpreted as overweight at the individual level, but it is indicative of obesity at population level.

In spite of its limitations, notably skewing of BMI towards higher values, the NCHS/WHO reference was recommended on a provisional basis for adolescents, as it was deemed important to use only one reference population for all recommended anthropometric indicators, be it only for uniformity of reporting purposes. Age- and sex-specific BMI curves for children and adolescents have been developed in France (Rolland-Cachera et al, 1991), UK (Cole, Freeman and Preece, 1995), USA (Must et al, 1991; Hammer et al, 1991; Rosner et al, 1998), Italy (Luciano, Bressan and Zoppi, 1997), and Sweden (Lindgren et al, 1995). The UK, Italy and Sweden curves are adjusted for skewness using the least mean square method of Cole (1990), which allows to express individual BMIs as exact percentiles or standard deviation scores. French BMI reference data appear lower than the other reference sets, possibly owing to secular trends, since the French data are older.

In a study of Nigerian adolescent girls, for instance, data were adjusted for maturity status according to WHO recommendations (Brabin et al, 1997). Median age at menarche was calculated to be 14 years in Nigeria and 13 in the British reference population and therefore, one year was subtracted from the chronological age associated with each mean height, and the percentage of girls falling under the lower BMI cut-off (9th percentile) was recalculated. Using the 9th percentile of the British reference (Cole et al, 1995), there is no continuity problem between adolescent and adult cut-offs (18.5, Bailey and Ferro-

Luzzi, 1995). What this pointed to was that using the recommended 5th percentile of NHANES II equated at age 19 to a cut-off value of 16. The study underlined the need to refine the definition and interpretation of low BMI in adolescents.

In clinical settings, more direct measures of body fat, such as skinfold thickness, may be useful to confirm that the high BMI reflects a high adiposity level, rather than a large body frame or a high muscle mass. However, cautious interpretation of skinfold thickness measurements is needed as there may be large differences between racial groups in the distribution of subcutaneous fat, whether at adolescence or other periods of the life cycle (Zillikens and Conway, 1990). Available information suggests that there is a more central distribution of body fat in Africans and other racial groups compared to Caucasian adolescents (Kurz and Som, 1998; Delisle and Favron, 1994). Therefore, this may not be a reliable method of assessing obesity in multiple racial groups. Waist circumference and waist-hip ratios are also used as measures of body fat distribution, and provide indicators of metabolic disease risk (Freedman et al, 1995). However, their usefulness is limited in the absence of validated cut-off points.

In the USA, overweight is integrated into routine screening of adolescents, according to the American Medical Association guidelines for adolescent preventive services (Himes and Dietz, 1994; Elster and Kuznets, 1995), and the suggested criteria is a BMI greater than the 95th percentile (compared to the 85th for WHO). The strategy, aimed at early detection of obesity and eating disorders, involves not only monitoring of BMI (for detection of overweight and of underweight as well), but also of dietary patterns and body image on a yearly basis, with follow-ups as required (see also section 4.5.5 on prevention of eating disturbances).

At a recent workshop convened by the International Task Force on Obesity (Dietz and Robinson, 1998), it was suggested to use the adult indices of overweight to establish cut-off percentiles for adolescents and for children, while pursuing efforts at developing an international reference population, in order to compare the prevalence of obesity among countries. Cut-off points for grade 1 and grade 2 overweight (rather than obesity, more pejorative) would correspond respectively to BMI values of 25 and 30 in late adolescents and adults, which should correspond roughly to the 80th and 95th percentiles. However, the workshop recommended caution when using the BMI cut-off points to assess the prevalence of obesity in different populations, such as Hispanics, Asians, and other populations with a high prevalence of stunting.

BMI measurement of adolescents is recommended whenever and wherever feasible, irrespective of the main type of nutrition problems to be expected, and without waiting for more specific reference data. Whether too high or too low, inadequate BMIs in adolescents should trigger an appropriate response of health-care providers.

4.5.1.2 Dietary inquiry

Anthropometric assessment has to be complemented with an assessment of adolescents' eating patterns, even if this is done with a rather crude method. Food frequency questionnaires have been found valid and useful to examine eating patterns and intakes of adolescents (Rockett and Colditz, 1997; Cavadino et al, 1999). Through a simple tool like a context-specific food frequency questionnaire, such as developed for vitamin A (HKI 1994; IVACG 1989; Delisle 1998b), it may be possible to identify potential dietary inadequacies in other nutrients, for instance in vitamin C, folate, iron, zinc, calcium and protein. The dietary inquiry is also helpful in detecting potential eating disorders. Both in cases of high or low BMIs, a rough estimation of physical activity level will help better understand the underlying factors.

In adolescents, it may be interesting to rely on self-administered questionnaires to examine food habits and eating patterns, except for those who have very little schooling.

The dietary inquiry is intended to provide hints of eating inadequacies or problems, and to serve as a basis for counselling and education. There is no standard dietary advice. Problems may pertain to food insecurity, which constrains access to enough food or enough variety. Number of meals, and their

composition, particularly in non-staple food items, are powerful indicators of food security or insecurity, as observed at the family level (Ali and Delisle, 1999). Inappropriate food choices owing to personal preference or cultural factors may be identified, with too little or too much of certain types of foods. Finally, the enquiry may reveal a risk of eating disorders, and for this, questions on body image and dieting are in order.

4.5.2 Control of iron and other micronutrient deficiencies in adolescents

4.5.2.1 Iron deficiency and anaemia

Iron deficiency is the most widespread form of micronutrient malnutrition around the world and yet it is the most neglected. It is regarded as the main nutritional problem in adolescents, boys and girls, and particularly so in girls (see Chap.3). Apart from routine administration in pregnancy, which is not always effective, other affected groups are little reached by programmes. Pregnancy may be too late for improving iron nutrition, considering the high demands that can hardly be met. In many developing countries, iron deficiency is most highly prevalent in pregnant women, followed by children of preschool age, and non-pregnant adolescents. This was the case in Indonesia (Gross et al, 1997). Anaemia control programmes, when successful, are recognized as highly cost-effective interventions among adolescents and adult women, in terms of infant deaths averted (World Bank 1993).

Considering all the causes of anaemia and their relative importance throughout the life cycle and using Africa as case study (Gillespie and Johnston, 1998), it was concluded that the low bioavailability of dietary iron was the principal determinant at all ages, and that intestinal helminths were also a major factor, particularly among school-age children and adolescents. It can be suggested that adolescents are a key target group for inclusive approaches that combine environmental sanitation, hygiene, and regarding food, consumption of vitamin C-rich foods, which enhance iron absorption (Hunt et al, 1994), avoidance of absorption inhibitors such as tea at meal time, emphasis on processes such as fermentation and germination as additional means of increasing iron bioavailability, and finally, increasing as much as possible the intake of animal sources of iron. Evidence of impact of such approaches is however scanty, and as underlined elsewhere (Favin and Griffiths, 1991; Gillespie 1998), the interpersonal communication component requires community-level workers, in health and other sectors, who are fluent enough in strategies of behavioural change to induce and sustain appropriate modifications among adolescents. In addition, supplementation should be considered for girls where anaemia is widespread, before the first pregnancy (Gillespie 1998).

Where the prevalence of anaemia is high (above 30%), it is recommended that iron supplementation (plus folate in girls and women) be universally implemented in pregnant women, under-five children, and girls and women from 10-49 years of age (UNICEF/WHO 1994). When the prevalence of anaemia in pregnancy is 40% or more, iron supplementation should continue during three months postpartum, according to recent WHO/UNICEF/INACG guidelines (Stoltzfus and Dreyfuss, 1998). These guidelines also provide up-to-date information on the prevention and treatment of iron deficiency anaemia, and on the treatment of severe anaemia. Apart from supplementation, food-based interventions and public health measures (helminth and malaria control) are appropriately discussed, while underlining the dire need for information on the extent of improvement in iron intake and absorption that can be achieved through dietary improvements accessible to poor populations.

Iron supplementation should be combined with measures to improve vitamin A status if the deficiency is known to be common, since poor vitamin A status may limit the effectiveness of iron (Bloem 1995). It has also been suggested that vitamin A could be one factor of menorrhagia in adolescent girls (see Chap. 3).

Operational problems with iron (and folate) supplementation programmes are common: supply shortages, irregular distributions, inadequate coverage of the target population by health-care services, lack of training of personnel, and limited compliance (Gillespie et al, 1991). These factors are a cause for concern as they underlie the lack of effectiveness of iron supplementation, in spite of demonstrated efficacy in well-controlled trials (Yip 1996). Several recommendations have been made to improve

effectiveness of iron supplementation programmes, including the use of village-based birth attendants and community-based organizations for distribution (Stoltzfus and Dreyfuss, 1998). Schools and youth groups are among the community-based structures that could be used for delivery of iron (and folate) supplements to adolescent girls, in addition to village health workers.

Based on accumulating evidence of comparable efficacy with daily supplements, weekly dosing of iron is proposed as a practical and economical means of improving the iron status in developing countries (Ridwan et al, 1996; Angeles-Agdeppa et al, 1997; Gross et al, 1997). In Indonesian non-pregnant adolescent girls, a double-blind randomized trial showed that a similar dose of iron (combined with retinol and vitamin C) given on a weekly basis was as effective at the daily dosage in improving iron status, while entailing less side effects (Angeles-Agdeppa et al, 1997). Similarly in Malaysia, hemoglobin and ferritin concentrations were shown to increase significantly in adolescent girls following weekly supplementation with iron combined or not with folate (Tee et al, 1999). However, these findings may in part reflect better compliance with weekly than daily supplementation, and there are conflicting results. For instance, in a study on comparative efficacy of weekly and daily supplementation in iron deficient but non-anaemic and non-pregnant women, it was found that there was no specific absorption advantage to weekly over daily dosage, while the latter also fell short of requirements for those situations in which iron supplementation is widely used (Cook and Reddy, 1995). It was suggested to look into iron preparations that would have less side effects, as these are to a large extent responsible for limited daily compliance, rather than less intensive iron supplementation programmes. However, these preparations may increase the cost, and in situations where weekly supplementation is sufficient to control the deficiency, it may be an adequate option. Multiple micronutrient deficiencies also need to be considered in populations at risk of iron deficiency and anaemia, as suggested by the observed lack of hemoglobin response to folate alone in adolescent girls with low ferritin levels (Tee et al, 1999).

Whilst weekly supplementation is potentially promising for school-age children, adolescents and non-pregnant women, the current recommendation of INACG, UNICEF and WHO (Stoltzfus and Dreyfuss, 1998) remains supplementation of iron on a daily basis for pregnant women and young children. Efficacy in demonstration trials may not translate into higher effectiveness under field conditions (Yip 1996), as conditions other than compliance may not be better met with weekly than daily supplements: regular supply, an efficient delivery system, and adequate counselling of women. Only compliance may be easier with the weekly supplement, because of less frequent side effects. Weekly administration, but under supervision, may ensure efficacy.

4.5.2.2 Iodine deficiency

Iodine deficiency represents a major public health problem in many areas of the world. At this time, most countries have undertaken, or are on the verge of doing so, salt iodization, which has been recognized as the most cost-effective method for the control of iodine deficiency (Alnwick 1998). Already in 1996, approximately 60% of the salt consumed in developing countries was iodized, compared to less than 10% just six years earlier (Alnwick, *ibid.*). However, iodine supplementation as an alternative or complementary intervention will continue to be needed in those endemic areas where iodized salt is not practicable, available or accessible (Solomons 1998), and where alternative fortification measures have not been implemented, for instance iodization of well water (Fisch et al, 1993) or of irrigation water, as in parts of China (DeLong et al, 1997). Intermittent oral doses of iodized oil is a preferred prophylaxis measure. The duration of its effectiveness, which may extend up to one year or more, is influenced by many factors, and was shown to be reduced, among others, by a limited amount of body fat, the presence of intestinal parasites, and consumption of cassava (Furnée 1997). There are other alternatives, a useful and low-cost one being the direct oral administration of a potassium iodide solution. According to a study among primary-school children in Zimbabwe (Todd and Dunn, 1998), this form of supplementation is safe even if large doses are given (unlike Lugol solutions), it is practical and it is effective if given at least once a month at a dose of around 30 mg (in a 10% solution). Women of reproductive age in deficient areas are a primary target for iodine supplementation, as the most damaging consequence of iodine deficiency is the irreversible alteration of nervous system development during the early stages of foetal life. However, this group may be more difficult to reach on a regular basis than

schoolchildren, and this is one merit of iodization (Alnwick 1998), and more generally, food fortification, to provide reliably the supplement to hard-to-reach population groups.

In iodine-deficient areas, young women are the priority target group for control of the deficiency in order to prevent the harmful effects on reproductive health and mental development of the child. Studies provide conclusive evidence that the administration of iodized oil prior to, or during, pregnancy, prevents endemic cretinism and brain damage, but iodine deficiency must be corrected before, or early in gestation (Delange 1996). In China, for example, it was observed that past the second trimester of pregnancy, iodine supplements no longer adequately protected the foetal brain from the damage of iodine deficiency (Xue-Yi et al, 1994). The aim should be for women to have a normal iodine status at the onset of pregnancy, and for this, adolescent girls should be targeted, in school and in other settings alike. In areas where iodine deficiency is endemic, induced hyperthyroidism is a problem that occurs after the introduction of iodine in any form, even iodized salt. However, this occurs mainly in older subjects with nodular goitres, and it is recognised that younger people are not affected (Stanbury et al, 1998). Goitre assessment and treatment protocols have been published (WHO 1996d;1997e).

4.5.2.3 Vitamin A deficiency

Vitamin A deficiency has long been considered a problem primarily among children under five years of age. It is now apparent that it may be widespread among women, and that it contributes to maternal mortality as evidenced in supplementation studies (West et al, 1999), and of low retinol level in maternal milk (Stoltzfus and Underwood, 1995). The deficiency may also be common among adolescent girls, and as already stated, it is entangled with iron deficiency (see Chapter 3). Again, adolescence may be a good time to prevent vitamin A deficiency, primarily through food. Adolescent girls with vitamin A deficiency evidenced by night blindness are to be treated with high dosage retinol according to a well-established protocol (WHO 1997f).

In contrast with iodine and iron deficiency, vitamin A deficiency may be largely prevented and controlled through food-based approaches, for plant foods containing provitamin A carotenoids are (or could) be available nearly everywhere, and they are usually not beyond the reach of poorer groups. For iron, supplementation is usually required in addition to efforts at increasing intake from foods, at least during pregnancy. Iodine deficiency is an ecological more than a dietary problem, and the long-term solution is iodization of salt, water, or other appropriate food vehicles. Limited but highly variable bioavailability of provitamin A carotenoids from plant foods is certainly of concern (de Pee et al, 1996; 1998b), but tubers and fruits with carotene in chromoplasts appear to be more bioavailable than green leafy vegetables with carotene in chloroplasts (de Pee et al, 1998b). Red palm oil, which does not have a vegetable matrix, is the highest vegetable source of carotene, and it was shown to be as effective as high-dose daily supplements of retinol in improving vitamin A status of school-age children in India (Mahapatra and Manorama, 1997). In addition to the now famous social marketing approach adopted in Thailand to promote a provitamin A-rich vegetable (Smitasiri et al, 1993), other examples of successful vitamin A programmes based on food systems and dietary modifications are now available. In Indonesia, a social marketing campaign promoting eggs and dark-green leafy vegetables proved effective in increasing consumption of eggs, vitamin A intake, and vitamin A status of mothers and children aged 12-36 months (de Pee et al, 1998a). This suggests that even in poor communities, some increase of animal sources of vitamin A can be achieved. In Nepal, nutrition education was shown to be as effective in reducing under-five mortality as vitamin A capsule distribution, although the cost of the former may be higher to reach the same level of impact as the latter, in those areas with low literacy and limited communication channels (Pant et al, 1996). More evidence is still needed on the effectiveness of various food-based vitamin A programmes, including gardening, food processing, commercial marketing and food-to-food fortification schemes.

Periodic high-dosage vitamin A supplementation in school-age children in addition to under-fives (and one dose post-partum in women) is currently under consideration in areas where vitamin A deficiency is widespread. Adolescents are not targeted for the time being. Unless more data on nutritional status and micronutrient status of adolescents becomes available, it is extremely difficult to take a stand on this issue. However, there are indications that adolescent girls may be at high risk (see Chapter 3), and

although emphasis should be on foods, location-specific combined strategies for vitamin A would need to be defined for them. This implies that adolescents are included in surveys or surveillance schemes, which is seldom the case.

4.5.2.4 *Other micronutrient inadequacies*

Iron (with folic acid during pregnancy), iodine and vitamin A were up to now the priority micronutrient deficiencies addressed by programmes and, except for iodine, strategies focused primarily on supplementation, while insisting that long-term prevention be based on dietary changes, combined with public health measures. It now seems that other micronutrient deficiencies may be widespread in developing countries, and large-scale supplementation may soon be advocated. Zinc could be the first candidate, perhaps followed by calcium, selenium, vitamin C, magnesium, etc.

Regarding zinc, the deficiency is suspected to be widespread in many developing countries (Sandstead 1991). It is associated with poor growth and development, and impaired immunity. Observational studies have suggested an association between maternal zinc deficiency and pregnancy outcome (see section 4.5.3). As there are interactions between zinc and vitamin A, a deficiency in either one may conceivably affect the other (Christian and West, 1998). Studies have reported correlations between vitamin A and zinc status, but the interaction is still poorly understood. Some zinc supplementation and fortification studies have suggested a positive effect on growth of children or adolescents (see under Section 3.2.2), but it is still too soon to advocate specific measures in adolescents, as further research is needed first.

Inadequate intakes of calcium may be one factor of osteoporosis in older age. Low consumption of dairy products, notably in adolescence, has been associated in developed countries with lower mineral bone mass, and increased osteoporosis risk in adulthood (see Chap. 3). Recommended intakes of calcium have been increased in the USA (National Academy of Sciences 1998), and Canada is also considering doing so (Murray 1996). However, there is little evidence that calcium deficiency is as much of an issue in non-Caucasian populations of developing countries, other than in very limited areas¹⁶. Dietary intakes may be higher in calcium than usually assumed in the developing world, owing to the common practice of eating poultry, small animal, and fish bones, and of geophagia. Furthermore, the much lower intake of fat, and of protein, may be responsible for a higher bioavailability of calcium in developing countries. Genetic factors may also be involved, and Africans appear to retain calcium better than non-Africans. Physical activity and exercise are other factors to take into account. All these factors may help explain why bone density of Gambian women was little different from that of British women, in spite of a much lower calcium intake (Dibba et al, 1999). Calcium nutrition is another area where research is needed.

4.5.2.5 *Some comments on micronutrient strategies*

One problem with nutritional deficiencies, as suggested by results of supplementation studies on linear child growth (Allen 1994; Rosado 1999), is that once a specific deficiency is controlled, another one may become limiting, and the process could well be endless. In Mexico, for example, it was found that zinc and iron supplements, alone or in combination, had no effect on growth of under-five children, whereas a multiple supplement combining five micronutrients known to be in short supply in children's diets significantly increased linear growth among children of lower socioeconomic status compared with placebo controls. Likewise, in considering the current conceptual shift from prevention of deficiency signs to promotion of optimal intakes for various health benefits (antioxidant benefits of vitamin C, for instance: Levine et al, 1999), the recommended intakes are increasing, and so should the theoretical need for supplements. There are data suggesting a protective role of supplements of vitamins C, E, β -carotene, selenium, zinc, in addition to well-documented benefits of iron, folate, iodine and vitamin A to correct pre-existing deficiencies. For instance, there is increasing evidence that generous vitamin E intakes may reduce the risk for certain cancers (Smigel 1992) and cardiovascular disease (Rimm et al, 1993). However, supplements are not devoid of risk and excess intake of many nutrients is associated

¹⁶ Golden M, Hambraeus L, Calcium recommendations, Discussions of NGO Nutrition Discussion Group, 1997 (www.univ-lille1.fr/pfeda/Ngonut/)

with adverse effects (Chandra 1998). For instance, large amounts of zinc may result in impaired immunity and increased LDL-cholesterol; excess vitamin C may precipitate kidney stones in susceptible individuals; selenium is toxic at relatively low doses (barely five times the recommended intake); and excessive doses of vitamin A, iron, and iodine are not innocuous. Another difficulty is that there are intricate interactions among micronutrients, and supplements of one may have adverse effects on the other. For instance, vitamin E antagonizes the action of fat-soluble vitamins. Iron at high concentration may negatively affect zinc absorption, but this effect is not observed when iron and zinc are given in a meal (Whittaker 1998). Nutrient imbalances of dietary origin appear much less likely than with supplementation.

It may be wise at this time to give due attention to means of improving the nutritional quality of diets as such, through diversification among other approaches, rather than constantly expanding supplementation nutrients and target groups. In the long run, it is likely more cost-effective to produce more food locally, with income and employment effects, than to increase the size of the nutrient supplements import bill. Furthermore, there is growing evidence that foods are not only mixtures of nutrients, but provide other components whose protective roles are not totally elucidated as yet, so that getting the nutrients in pills and in foods may not be the same. Food-based approaches to long-term prevention are widely supported (Gillespie 1997; Howson, Kennedy and Horwitz, 1998; World Bank 1994), at least in principle. A major impediment to food diversification schemes for micronutrient nutrition may be that evidence of their effectiveness is still lacking, partly because such interventions are complex and long-term (Howson, Kennedy and Horwitz, *ibid.*). However, evidence is slowly accumulating. Evaluation research should also encompass, whenever feasible and appropriate, impact on overall nutrition and other positive outcomes such as income effects.

An alternative or complementary approach for those nutrients that cannot practicably be obtained in adequate amounts through foods, and for population groups at high risk, is to combine them as multiple micronutrient supplements to be taken, say, weekly, once their effectiveness is demonstrated (Alnwick 1998). Nonetheless, outside of pregnancy (see below), our view is that nutrient supplementation should be regarded as the exception rather than the rule, considering that globalization of a typically western trend, that is, a pharmaceutical approach to nutrition, is not warranted because of questionable sustainability, effectiveness and even efficacy (Delisle, 1994).

Multiple micronutrient deficiencies are likely more common than single deficiencies, and therefore, it is recommended that plans for sustained impact consider interventions to target multiple deficiencies, and to incorporate all four strategies with context-specific variations in relative emphasis – supplementation, fortification, food diversification and public health measures (Howson, Kennedy and Horwitz, 1998).

Food fortification is an interesting alternative to supplementation for prevention purposes where feasible, and multiple fortification is often considered. Fortified foods could target only certain vulnerable groups, and school-based programmes may be well suited for providing fortified foods to children and adolescents as a means of improving their micronutrient status. For instance, in southern Africa, a randomized, case-control trial was conducted on vitamin- and mineral-fortified biscuits and drinks given as snacks to primary-school children (van Stuijvenberg et al, 1999). The biscuit was fortified with β -carotene, iodine and iron (50% of the recommended daily allowance), and the drink with vitamin C. After one year, significant improvements in iron, vitamin A and iodine status were observed, and those who needed it benefited most from the intervention. The concept of a (fortified) school snack, rather than a meal, is also interesting as otherwise there may be substitution of school meals for home meals. The biscuit is now commercialized and marketed. The price appears low, which may allow the fortified product to be accessible for poorer groups.

4.5.3 Nutrition integration in antenatal (and postnatal) care for adolescents

The task of health-care providers is very important in the antenatal and postpartum period, in order to protect and improve nutritional status of the mother and the infant, and to support breastfeeding. In pregnant adolescents, this role is particularly crucial. However, the emphasis should be first on minimizing

the number of adolescent pregnancies where it can be done. Health care should collaborate with schools and the medias in educating for responsible (and safe) sex.

4.5.3.1 Is antenatal care nutritionally effective?

The effectiveness of antenatal care in general, and for adolescents in particular, is questioned in developing countries (McDonagh 1996; Brabin et al, 1998). In a review of health problems and health care in adolescent pregnancy (Treffers 1998), the inadequacies of antenatal care in developing countries, in particular for pregnant adolescents, are also underlined. Antenatal care may be scarce for women of any age. There is a high proportion of adolescents getting no antenatal care, or else coming late in their pregnancy. Furthermore, health personnel may be little accommodating to reproductive health problems of adolescents, who may not get the care that they need. There are many reasons to explain that young people do not attend clinics as much as older people: the fear of being turned away or scorned because of their young age; their need for information and sympathetic counselling whereas clinics designed for adults focus on diagnostic and curative services; and fear of lack of confidentiality (Kurz, 1997).

In Malawi, it was observed that in spite of antenatal care attendance on average higher than the four visits recommended by WHO, pregnancy morbidity and adverse birth outcomes were all too common. For instance, 40% of primiparae <17 years gave birth to low-birth-weight babies (26% for those aged 17-19 years), and there was a high prevalence of malaria (34% in nulliparae) and severe anaemia (11%). There was also a high rate of HIV, but preventive intervention has to occur before pregnancy (Brabin et al, 1998).

According to a review of several studies (Treffers 1998), a positive relation was nonetheless often observed between antenatal care and pregnancy outcome in adolescence, in terms of higher birth weights and lower perinatal mortality. Benefit is also suggested in studies carried out in developed countries, as seen below, but there are contradictory findings. In order to demonstrate impact, rigorous case-control studies are needed, which may not be easily done. Another factor of variation to consider is the quality of care, and not only the number of antenatal visits.

Based on a retrospective study of pregnant adolescents who had or had not participated in a nutrition intervention programme consisting of dietary counselling, prenatal monitoring, and food supplementation ('Higgins program', Montreal), Dubois et al (1997) concluded that this type of nutrition intervention improved adolescent pregnancy outcome. Birth weights were on average 55 g higher in the intervention group, rate of low birth weight was 39% lower, and that of very low birth weight 56% lower. This programme was reportedly more effective than the Special Supplemental WIC Programme in the US (Avruch and Cackley, 1995) for reduction of low birth weight, very low birth weight, and preterm delivery, but the US programme report did not include only adolescents. Those in the Higgins program had better pregnancy outcomes than non-intervention adolescents, although their weight gain only averaged 3 kg more. Nevertheless, as the findings are not based on a randomized trial and historical controls were selected, the study is not devoid of bias. In the USA, comprehensive clinical programmes, including nutrition services, reportedly reduced the unfavourable consequences of teenage pregnancy (Rees and Worthington-Roberts, 1993).

A recent UNICEF working paper (Gillespie 1997) provides a thorough review of maternal and adolescent malnutrition, of options for action, and of research needs. What follows is to a large extent taken from this document. It may be underlined again that nutrition interventions with adolescent girls are more relevant before pregnancy as a means of improving nutritional status at onset of pregnancy, and that delaying the first pregnancy should be the central goal anywhere (see Chap. 3).

Nutrition-related activities of antenatal care are better discussed under screening for risk factors, monitoring and nutrition interventions. With a few exceptions to be outlined, antenatal care for adolescents may be regarded as very similar to standard care (Treffers 1998). The main distinction is that it is even more critical in adolescents, and health-care providers need to be responsive to adolescents' psychological needs and vulnerability.

4.5.3.2 Screening for risk factors

In spite of general agreement over a basic core of risk factors relating to age, parity, height and birth interval, wide variations in the cut-off points for risk have been noted (McDonagh 1996). However, this is not regarded as a major problem, considering variable sensitivity and specificity of cut-offs as indicators of maternal or foetal risk, as discussed below in the case of anthropometric indicators.

4.5.3.3 Initial anthropometric assessment and weight-gain monitoring

Pregnant adolescents are at increased risk by definition. A short stature or a low pre-pregnancy weight are additional risk factors. Heights ranging from 140-150 cm have been proposed as cut-off points for screening of pregnant women at increased risk of intrauterine growth retardation and of eventual complications at delivery (WHO 1995b). At the onset and at any time during pregnancy, weight or BMI below the 25th percentile of the reference values based on the results of the WHO collective study (WHO 1995b) has been suggested for screening pregnant women at increased risk of unfavourable pregnancy outcome, but reference data on weight gain in pregnancy need to be improved. Screening should trigger an appropriate response depending on cases, indicators and local conditions: further investigation; referral; and, for nutrition, counselling, nutrient and food supplementation. Short height reflects nutritional past, and it is little relevant for current nutritional status assessment, unlike pre-pregnancy BMI, or weight gain, which may identify women who are likely to benefit from nutritional intervention. At any time during pregnancy, mid upper-arm circumference may be used as a substitute indicator if weight is not available, although it is less sensitive and specific; cut-off points vary between 20.7 and 23 depending on studies (WHO 1995b).

Routine measurement of weight is recommended during pregnancy when resources permit, in order to identify excess or inadequate weight gain. As shown in the WHO Collaborative Study (WHO 1995b), inadequate pre-pregnancy weight and inadequate weight gain have cumulative effects on risk of intrauterine growth retardation. In adolescents, adequate weight gain during pregnancy is more critical than in adults. Even in the USA, there is more risk associated with inadequate, than with excessive, weight gain during adolescent pregnancy (Rees et al, 1992a).

WHO (1995b) has tentatively suggested the 25th percentile of attained weight at different stages of pregnancy (20th, 28th, 36th weeks) as cut-offs for screening for increased risk of intrauterine growth retardation. Based on median weight of non-pregnant women (NPW), estimated 25th percentile attained weight at various stages of pregnancy are given below:

Level of under-nutrition in the population	Attained weight below which increased IUGR risk is expected		
	20 weeks	28 weeks	36 weeks
High	NPW - 1.5 kg	NPW + 2 kg	NPW +4.5 kg
Low	NPW - 3	NPW + 1	NPW +4.5

In the new Guidelines for pregnancy in Canada (Health Canada 1999), recommendations on weight gain during pregnancy, depending on BMI at onset of pregnancy, are:

BMI<20	12.5-18 kg
20-25.1.1	11.5-16
>27	7.0-11.5

However, for pregnant adolescents, BMI is considered appropriate to assess baseline weight only if there are at least two years since menarche (see 4.3.1). Current research suggests that adolescents need to gain at the highest recommended rates in the second and third trimesters, and to gain early and continuously to bear optimal weight infants (Rees et al, 1992).

Having detected risk and its magnitude, corrective action undertaken is important, and deserves as much attention as identifying the risk.

4.5.3.4 *Nutrition intervention*

Nutrition intervention during pregnancy essentially includes nutritional advice, micronutrient supplementation and food supplementation. These are normally integrated in other components of prenatal care. As part of nutrition monitoring of pregnancy, dietary inquiry and advice is recommended, and even more so if inadequate weight or weight gain is identified.

- **Nutritional advice:**

A major criticism that can be directed at nutrition-related pregnancy monitoring, and this also applies to growth monitoring (Cervinkas, Gerein and George, 1992), is that the identification of inadequate weight or gain does not seem to trigger further investigation or inquiry, and appropriate action. Such determinants as heavy workload, malaria and other infections, for instance, would have to be considered in pregnant women (McDonagh 1996). Similarly, dietary restrictions and withholding of some animal products, which were found to be quite common in many cultures (Brems and Berg, 1988), are important aspects to take into account. Nutritional advice was not considered to be an effective intervention in an assessment of antenatal care in developing countries (McDonagh 1996), although this judgement was based more on assumptions and doubts stemming from field experience, than on evaluation findings, which are indeed scarce.

Our own view, which would need to be substantiated by observational or research evidence, is that health-care providers seldom have a clear idea of the kind of relevant and context-specific dietary advice that can be given to pregnant women, adolescent or not, owing to the fact that they often have only a superficial knowledge of dietary patterns of women, combined with the absence of local dietary guidelines. Developing simple tools for dietary inquiry and for appropriate advice on that basis should be regarded as a priority for improved nutrition intervention during pregnancy. Problem trees and solution trees as used in participatory rural appraisal (Chambers 1994) may prove useful for the purpose.

- **Micronutrient supplementation**

It is recognized that reduction of anaemia is one of the most significant contributions of antenatal care (WHO 1992), and in conjunction with iron/folate supplementation, it was shown that where malaria is highly prevalent, prophylaxis is a successful intervention (Brabin 1991). When applied to pregnant adolescents, this combined prophylaxis reportedly resulted in growth in height, reducing the risk of obstructed labour (Harrison et al, 1985). In a randomized, double-blind, placebo-controlled, community-based trial of daily oral iron supplementation of pregnant women by traditional birth attendants in The Gambia, iron supplementation was found to improve iron status, without increased susceptibility to malaria, and birth weight was increased by an average of 56 g (Menendez et al, 1994). There are, however, operational problems with iron supplementation programmes in pregnancy, with resulting mitigated results (Stoltzfus and Dreyfuss, 1998), which were discussed above (see section 4.5.3).

Supplementation with 400 mg of folic acid at the onset of pregnancy significantly reduces the incidence of neural tube defects, and supplementation should not start later than the first trimester. If only 250 mg folate preparations (in combination with iron) are available, these are to be used until higher dosage supplements become available (Stoltzfus and Dreyfuss, 1998).

High-dosage vitamin A supplements are not recommended during pregnancy because of potential teratogenic effects. However, in areas where maternal vitamin A deficiency is common, notably in Asia, low-dose supplements during pregnancy may be highly beneficial (WHO 1998c). Night blindness may be a common occurrence in pregnant women (Christian et al, 1998) and should be detected by antenatal care. In a double-blind cluster randomized trial of weekly supplementation with retinol or b-carotene (7000 mg retinol equivalents) among pregnant women in Nepal, the risk of death related to pregnancy was lowered by 44% in women receiving retinol or b-carotene (West et al, 1999). The decrease in maternal mortality attributed to obstetric causes appeared more important with b-carotene than with retinol, which could suggest that some benefit is related to antioxidant properties of b-carotene, and which supports a food-based approach to vitamin A status improvement. According to current recommendations (WHO 1998c), where vitamin A deficiency is widespread among children and maternal diets are poor in vitamin A, health benefits of vitamin A supplements may accrue to mother and child with little teratogenic and other type of risk in the following conditions: 1) 10.000 IU (3 mg) of retinol should be the maximum daily dose at any time during pregnancy; 2) A weekly supplement should not exceed 25.000 IU (8.5 mg), particularly between 15 and 60 days following conception.

In any case, supplements should not be presented or perceived as substitutes for dietary improvements, because of their questionable sustainability as a preventive approach, as already underlined. Every effort should be made to raise the intake of preformed or provitamin A intake from foods.

Iodine supplements need to be given as early as possible in pregnancy in those areas where iodine deficiency is widely prevalent, unless iodized salt (or water) is accessible. Unless corrected before the end of the second trimester of pregnancy, iodine deficiency will likely alter the brain development of the child, as shown in China (Xue-Yi et al, 1994).

In the USA, iron supplementation is recommended for all pregnant women, whether adolescent or not. In addition, supplements of calcium, folate, vitamins B6 and C are recommended for pregnant adolescents “at risk of inadequate food consumption” (National Academy of Sciences 1990). Lower SES and poor choices increase nutritional risk for pregnant teenagers. Those who are obese or poorly nourished at the time of conception, and those who have most recently reached menarche (2-3 years before conception) are at greatest risk of poor pregnancy outcomes in the USA (Rees and Worthington-Roberts, 1993). In low-income urban women in the USA, it was found that multivitamin/mineral prenatal supplements during the first and second trimesters of pregnancy were associated with a marked reduction of preterm delivery, and of low or very low birth weights; controlling for confounding variables further strengthened the effect (Scholl et al, 1997). This suggests that micronutrient deficiencies may also be common among poor pregnant women in developed countries, and that their correction is associated with a more favourable outcome of pregnancy. Among HIV-infected pregnant women, multiple-vitamin supplements were reportedly beneficial (Fawzi et al, 1998). Evidence gathered in developed countries strongly suggests multiple micronutrient supplementation as a relevant intervention for pregnant adolescents in developing countries.

Regarding zinc, strong associations have been observed between poor maternal zinc status and various indicators of poor pregnancy outcome, although supplementation trial results are still needed to define the public health importance of zinc deficiency worldwide (Caulfield et al, 1998). Similarly, it is suggested that zinc supplementation of lactating mothers may be beneficial to both mother and child, although supplementation trials are even more critically needed than in pregnancy (Krebs 1998).

Calcium supplementation during pregnancy was seen to reduce the risk of preterm delivery (but not impaired foetal growth), and of pre-eclampsia and pregnancy-induced hypertension, according to systematic reviews and metaanalyses of controlled trials (Carroli et al, 1994; Bucher et al, 1996; Gülmezoglu, de Onis and Villar, 1997). The findings of reduced incidence of hypertension, which is reportedly mediated by induced changes at the vascular smooth level, were regarded as providing sufficient evidence for recommending calcium supplementation in women at high risk of gestational hypertension (Atallah et al, 1998), although a large trial failed to observe similar benefits (Levine et al, 1997). Quite a few studies indicate that pre-eclampsia may occur more frequently among pregnant adolescents, according to a

review (Treffers 1998), and it may be speculated that calcium supplementation could be of benefit. A controlled supplementation trial also showed that calcium supplementation during pregnancy was associated with significantly lower blood pressure in the offspring without any effect on birth weight (Belizan et al, 1997). However, before a general recommendation can be made, the benefits of calcium supplements in Caucasian and non-Caucasian pregnant adolescents, while controlling for their calcium status, deserve further study.

Magnesium supplementation studies showed a lower incidence of low birth weight due to intrauterine growth retardation, but some methodological weaknesses may hamper generalization of the findings (Gülmezoglu, de Onis and Villar, 1997).

- Food supplementation

In developing countries, poorer women, adolescent or adult, are more likely to be undernourished, and food supplementation during pregnancy is seen as a potentially effective intervention. Metanalyses of data from controlled trials (Kramer 1993; Gülmezoglu, de Onis and Villar, 1998) revealed improvements, however modest, of foetal growth and birth weights with balanced energy/protein supplements. Randomized studies in the Gambia (Ceesay et al, 1997) suggest that benefit may be commensurate to the extent of the energy deficit, with larger increases in birth weights among severely undernourished women, particularly during the lean season. Furthermore, the impact of food supplementation on head circumference was minimal, which suggests that concerns about the risk of aggravating cephalopelvic disproportion are not substantiated. Similarly, in Guatemala, a long-term food supplementation trial showed that infants derived more benefit when the mother was malnourished (Winkvist, Habicht and Rasmussen, 1998). As shown also in Guatemala (Villar et al, 1992), maternal pre-pregnancy nutritional status (weight) and the rate of fat gain early in pregnancy were the indicators most closely associated with birth weight. This suggests that the maximum benefit to be expected will be achieved with early initiation of the supplementation.

However, there may be some concern with food supplementation of adolescent pregnant women, as it has been suggested that it may exacerbate the risk of intrauterine growth retardation, based on observations in animals (James 1997; Wallace et al, 1996, 1997). While in adult pregnancy the hormonal response is normally geared to optimizing the flow of nutrients to the foetus, the opposite seems to occur in adolescent pregnancies. Paradoxically, feeding young pregnant lambs well leads to a selective channelling of nutrients to the mother, who then thrives at the expense of the foetus. Obviously, research is needed to verify whether such an adverse effect may occur with food supplementation of undernourished pregnant adolescents.

While food supplements are shown to be beneficial when given to mothers who were nutritionally compromised, they represent only an interim solution. The underlying causes of women's malnutrition need to be sought.

We concur with the statement that the most reliable method of improving nutritional status of mother and infants is by improving the socioeconomic conditions in the country and through female education (McDonagh 1996). Along similar lines, it was concluded from a large review on effectiveness of prenatal interventions to prevent or treat impaired foetal growth (Gülmezoglu, de Onis and Villar, 1997) that combinations of interventions should be evaluated for their impact, considering that impaired foetal growth is a multicausal outcome which is highly dependent on socioeconomic disparities, and that well-controlled intervention trials are scanty.

- Nutritional care of adolescent mothers in the postpartum

During the postpartum, women, and particularly adolescents, require nutritional attention for breastfeeding support, for dietary advice and for food supplementation in conditions of severe lack of access to food, and for micronutrient supplementation where appropriate (vitamin A, iodine, iron), much the same as during pregnancy (WHO 1998d). It is reminded that nutritional requirements for

lactation may be even higher than in pregnancy. BMI monitoring is advised, and as suggested (WHO 1995), a cut-off point of 20.3 could be used at one month postpartum, with progressive return to standard adult cut-offs at six months.

Food or nutrient supplementation during lactation may be as important if not more than in pregnancy, for reasons outlined by Gillespie (1997). In addition to maternal nutritional status and well-being, the intervention may help:

- 1) to facilitate recuperation and replenishment of nutrient stores, for adequate pre-pregnancy weight for the next gestation;
- 2) to improve micronutrient content of breastmilk; studies show that volume and macronutrient composition of breastmilk do not change in an appreciable manner, but micronutrient concentration is responsive to maternal status in these micronutrients;
- 3) to improve nutritional status perhaps more effectively than during pregnancy, because of better compliance with supplementation, particularly in cultures restraining food intake during pregnancy; and
- 4) to enable the mother to maintain normal levels of physical activity, with benefits for the whole family.

Additional justification for increased attention to adolescent mothers stems from studies suggesting poorer lactational performance in adolescents, and among lower socioeconomic groups in particular, a negative impact of early pregnancy on children's nutritional status, on education and income (see Chap. 3).

Although there was at one time some concern about the possible shortening of the post-partum amenorrhea, owing to improved nutritional status of lactating women, such a risk has been deemed minor (Kurz et al, 1991).

4.5.4 Prevention and management of obesity

The prevalence of obesity is ever-increasing, and not only in developed countries. Its prevention is regarded as crucial and sensible for developing countries, and adolescents have to be regarded as a priority target group (WHO 1998a). Once obesity is established, its treatment is costly and by and large ineffective. The health burden attributable to excess weight and associated morbidity is likely to become huge. Obesity represents a major burden on health of individuals, and on health-care resources. In Canada, for instance, based on the national population health survey of 1994, it was found that obese respondents (BMI of 27 or greater) were more likely than non-obese respondents to suffer from stress, activity restrictions, and a number of chronic co-morbidities, including coronary heart disease, stroke, hypertension, diabetes, respiratory, gastrointestinal, and joint problems (Trakas et al, 1999). They were also more likely to consult with physicians, be prescribed several medications, and require excess disability days.

There are three critical periods for the development of obesity in early years, and the onset during those periods is believed to increase the risk of persistent obesity and complications (Dietz 1994): around the time of birth, between the age of five and seven years, and in adolescence. Effective weight management in childhood and adolescence is likely the key element of long-term prevention of obesity in societies (Davis and Christoffel, 1994; Epstein 1994). Schools should play a central role in this regard, for those children and adolescents that can be reached through them.

Strategies for the prevention of obesity revolve around healthy eating, physical activity, and behavioural modification to sustain these (WHO 1998a). Healthy eating, as discussed under nutrition promotion (section 4.4), should aim at increasing consumption of fruits and vegetables, complex carbohydrates, and discourage high-fat and possibly also high-sugar foods. In adolescents, building self-esteem and preventing undue fear of fatness may also be important strategic components.

Can obesity prevention be effective among adolescents? In adults, available evidence from community-based programmes is limited, but does not suggest that such programmes have impact during a follow-up period of up to seven years, although some methodological shortcomings have been noted (Douketis et al, 1999). Obesity prevention is nonetheless regarded as having high priority for health-care providers, in view of associated health risk, and of lack of long-term effects of weight reduction approaches. There is little research available on obesity prevention among children and adolescents, and the need for such programmes is stressed, notably among groups with a high rate of obesity and associated health problems such as American Indians (Story et al, 1999). Prevention of obesity is about helping young people and their families adopt different lifestyles, and creating supportive environments to healthful eating and physical activity.

There is some evidence suggesting that obesity management programmes may be more effective in children and adolescents than in adults. Interventions implemented in children between ages of 6 and 12 years have reportedly been successful in promoting long-term weight maintenance (Epstein et al, 1994; Willson 1994). A school-based interdisciplinary intervention on obesity among New England adolescents called 'Planet Youth' (Gortmaker et al, 1999) was also effective in reducing obesity, although only among girls. The randomized, controlled intervention trial lasted two school years. The intervention focused on decreasing television viewing, reducing consumption of high fat food, increasing fruit and vegetable intake, and increasing moderate and vigorous physical activity. Reduction in television viewing mediated the intervention effect. This project highlights a potentially promising school-based approach to reducing obesity among adolescent girls, and it supports the view that effective public health measures to increase participation in active rather than sedentary lifestyles is crucial (Gidding et al, 1996).

Because obese adolescents tend to remain obese as adults, and also because obesity in adolescence is already linked with increased cardiovascular and metabolic disease risk, early intervention aimed at weight reduction should be regarded as a relevant approach, even if effectiveness and sustainability are not fully demonstrated. This is particularly important when there is a family history of obesity, diabetes, dyslipoproteinemia, or hypertension. Conditions for which weight loss is recommended include hypertension, diabetes mellitus, sleep apnea, orthopedic abnormalities, and severe psychosocial stress resulting from obesity (Gidding et al, 1995). In management of cases of obese adolescents, modest weight loss, combined with treatment of co-morbidity, is advocated (WHO 1998a). There are nearly always only positive effects associated with sensible weight loss in obese persons, except perhaps for some bone density loss. Weight cycling resulting from 'yo-yo' dieting is not documented enough to be addressed at this time (WHO 1998a).

A case-control weight-reducing treatment for one year was assessed for its long-term effects on blood lipids and insulin in obese children and adolescents aged 6-16 years (Knip and Nuutinen, 1993). The intervention consisted of individual counselling or group therapy for behavioural (eating and exercise) modification. At the onset of the trial, serum lipid profiles and hyperinsulinemia in obese subjects suggested that insulin resistance syndrome (or X Syndrome) may already manifest itself in childhood. After one year of treatment, relative weight decreased by 16%, serum lipid profiles had improved, and there was a modest decrease in fasting serum insulin. The changes remained stable during the next year. After five years, many changes had reversed, but HDL-cholesterol remained elevated, and the average weight loss was 13% at this point. Increased HDL-cholesterol may improve the long-term prognosis in these subjects.

Efforts aimed at weight reduction should emphasize permanent healthful dietary and lifestyle practices. It has been observed, for instance, that obese subjects tend to skip breakfast (Cornelius 1991), and that this tendency, as well as that of eating foods that are not recommended from a nutrition standpoint, becomes more frequent as children grow older. It has also been shown that eating breakfast was an effective means of reducing fat intake and minimizing compulsive snacking, of reducing energy intake at subsequent meals, which suggests that it may be a useful practice in the framework of weight control (Schlundt et al, 1992). Eating breakfast may also have metabolic benefits, such as improved insulin sensitivity and more favourable blood lipid profile, even in young people (Jenkins et al, 1989; Resnicow 1991). Furthermore, positive effects on school attendance and performance (Simeon 1998; Jacoby, Cueto

and Pollitt, 1998) have been associated with school breakfast programmes, even in the USA (Murphy et al, 1998). Nutritionally at-risk and undernourished children are likely to derive even greater benefits from school breakfast (Pollitt 1995; Simeon 1998), and nutritional status improvements have been reported, in terms of growth or reduction of anaemia (Jacoby, Cueto and Pollitt, 1998; Powell et al, 1998). Eating breakfast may therefore be sound advice for weight management, as well as for nutritional metabolic, and school performance benefits.

Brazil is an example of a country in nutritional transition, with increasing rates of obesity and related chronic diseases. In a study of snacking patterns among middle-income adolescents in Manaus, it was found that although high-nutrient-density snack foods were available, adolescents preferred the low nutrient density items. Surprisingly, adolescents reported that they were more likely to be influenced by and to obtain nutrition information from family members than from friends (Doyle and Feldman, 1997). Thus, going beyond a focus on food availability and involving parents are suggested as promising strategies.

4.5.5 Prevention of eating disturbances

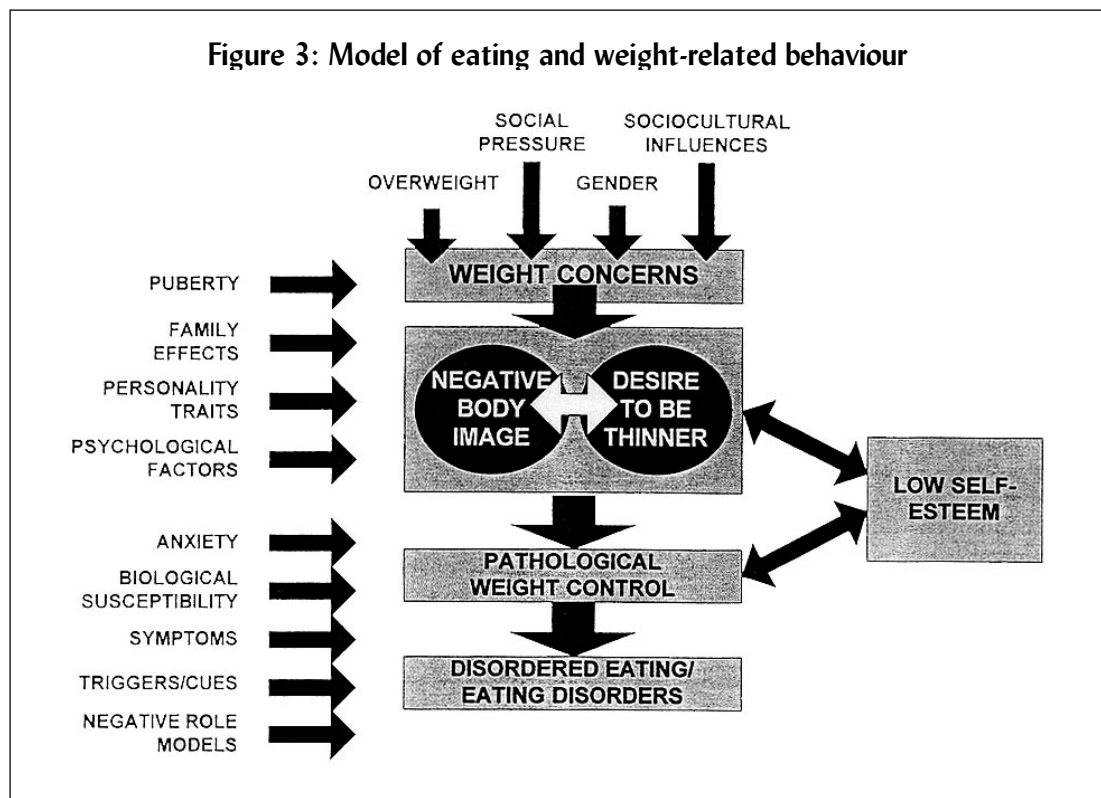
Unnecessary dieting is a highly prevalent behaviour, particularly in industrialized countries, and among adolescent girls. On the one hand, unnecessary dieting and repeated weight loss attempts may in themselves be a risk factor for obesity; on the other hand, it is well recognized that frequent dieting is one of the chief risk factors for eating disorders such as bulimia nervosa (French, Story and Perry, 1994). Primary prevention of eating disorders is therefore an important strategy directed at adolescents, along with obesity prevention and management; as both types of problems are frequently associated. Schools may be an ideal setting, for it can be assumed that in developing countries, such problems are more likely to occur or to develop among better-off adolescents, and therefore people who are still in school.

In a survey of high school students in the USA, 40% were trying to lose weight, and the proportion reached 61% in white and hispanic girls (Kann et al, 1995). The reduction of unnecessary dieting, using prevention strategies that target teenagers, is seen as a public health priority, at least in the USA. Factors that both predispose youth to unnecessary weight loss attempts and that are potentially amenable to educational interventions were analysed on the basis of the social cognitive theory, which contends that behaviours are adopted and maintained by the anticipated outcomes (Thombs, Mahoney and McLaughlin, 1998). The greater the anticipated reinforcement, the greater the likelihood that a behaviour will occur and be sustained. Greater self-worth and social confidence are expected outcomes that were strongly related to the frequency of dieting. Frequent dieting was also associated with lower self-esteem, and with the female sex. Actually, self-esteem was the best predictor of weight-reduction behaviours in general, including diet-pill use and purging. This study does not reveal whether low self-esteem and strong weight loss expectancies are the antecedents or consequences of weight reduction behaviours, but it strongly suggests that weight management education for teenagers should emphasize self-esteem enhancement. In addition, in order to prevent unnecessary dieting, curricular activities should be designed to sever the cognitive linkages between anticipated positive outcomes and weight reduction efforts. Distinguishing between healthy and unhealthy reasons for dieting is important. Instruction about healthy weight management needs to be multifaceted, and include accurate information to correct knowledge deficits and also put emphasis on psychosocial aspects of the problem. Cohort studies from childhood onwards would be required to study the nature of relationships between self-esteem and weight-loss expectancies, and the impact of failed weight loss attempts on these factors and on behaviours. Psychosocial determinants and correlates of weight-loss behaviours also need to be examined in a cross-cultural perspective.

There is a broad spectrum of eating disturbances, with anorexia nervosa and bulimia nervosa representing only the extreme (Rosen and Neumark-Sztainer, 1998). Disordered eating also includes frequent dieting, pathological dieting, and the so-called “partial syndromes”. Persons along this continuum are at physiological and psychological risk, although they do not meet the diagnostic criteria for anorexia or bulimia, and should benefit from appropriate treatment and counselling. Risks incurred are: stunted growth and delayed puberty in younger persons; risks associated with, for instance, induced vomiting;

psychiatric co-morbidity; and progression to overt eating disorders if not treated (Rosen and Neumark-Sztainer, 1998). Primary prevention of these disorders has to be given attention, and this is also relevant in developing countries, where young people are under a marked influence of western youth lifestyles and values, particularly in urban areas.

The model shown in Figure 3 (Rosen and Neumark-Sztainer, 1998) depicts the wide range of potential influences and demonstrates the need for integrated and comprehensive prevention programmes. Existing evidence suggests that personal factors predominate, and that social factors only have an indirect effect.



Preventive programmes should be strongly female-oriented, for girls are more exposed to these disorders. However, in school programmes in particular, boys could be included: these conditions are increasing in boys, and it is important that girls discuss with them on social and peer norms. Target groups may be quite young, as it has been shown that girls associate thinness with attractiveness well before adolescence, and that the best indicator of progression to frank eating disorders was weight concerns, which are already present in pre-adolescent and young adolescent girls. Rosen and Neumark-Sztainer (1998) report consensus for targeting groups aged 11-13 years. Primary prevention programmes have to be culturally appropriate.

Schools are particularly well suited to address the following, and indeed most preventive programmes have been done in schools:

- Reducing body dissatisfaction
- Critical thinking about sociocultural and peer norms
- Understanding physical development
- Improved knowledge about nutrition and weight control
- Skill development.

Schools could also identify high-risk youth or families, refer them for suitable treatment, and provide on-going support during and after treatment.

School-based programmes offer the most traditional venue for reaching youth, but their efforts will be considerably more effective if reinforced by community messages and backed by community resources; such a programme has been undertaken in Norway. Youth groups, particularly those with a high proportion of girls, could have an important role to play in places where there is a recognized risk of eating disturbances.

Prevention at the individual level will likely take place in a health-care setting, and the extent will depend on the level of perceived risk. However, little is actually known of the impact of health-service-based counselling for primary prevention of disordered eating. The higher the intervention level, the more difficult the approaches are likely going to be. Societal level involves actions to modify social norms on eating, and on desirable body size, which would require that advertising directed at adolescents, for instance, be more reflective of the varied body shapes and sizes to be found in the population, and move away from cultural stereotypes of female beauty. Interventions at national level may be somewhat more accessible, and efforts in the right direction have been done in many countries. Such action includes regulation against false and misleading advertising of weight-loss programmes, as well as improved access to nutritional and psychological counselling which might deter the onset of dysfunctional eating. However, more operational research on the effectiveness of different approaches to primary prevention is needed, as well as on factors of vulnerability and of resilience to sociocultural norms overemphasizing thinness.

Along with primary prevention at the individual level, early detection of eating disturbance signs should be in the hands of health-care providers, who for this have to be sensitized to the problem. Early clinical signs of an eating disorder include unexplained weight loss and secondary amenorrhea. Metabolic changes, such as hypotension, hypothermia and bradycardia occur with weight loss greater than 25% of ideal body weight and are, therefore, clinical signs found in extreme situations (Palla and Litt 1988). Starvation, use of laxatives and diuretics, and recurrent vomiting often lead to sodium and potassium abnormalities. The mortality rate from eating disorders is approximately 10% (in Elster and Kuznets, 1995).

One component of the dual strategy of the American Medical Association regarding adolescent preventive services in nutrition (Elster and Kuznets, 1995) consists of early detection of eating disorders and obesity, the other one being promotion of healthy eating. According to their Guidelines, the health-care provider should check for anorexia/bulimia, and for underlying organic disease when in presence of the following signs:

- a low BMI (<5th percentile), or:
- loss of 2 BMI points or:
- 10% loss of previous weight lost, or else:
- inappropriate feelings of being overweight or extreme measures to lose weight are reported.

In the case of chronic dieting behaviour combined with poor body image, a more in-depth assessment could be done, in order to help confirm a presumptive diagnosis of anorexia nervosa or bulimia, using instruments such as the Eating Attitudes Test (EAT) and the Eating Disorder Inventory (Williams 1987). The Dutch Eating Behavior Questionnaire (DEBQ) is another tool to assess eating disorders (van Strien et al, 1986). The eating disease inventory (EDI) includes three subscales assessing attitudes and behaviours related to eating and body shape: drive for thinness, bulimia and body dissatisfaction, and five subscales assessing general psychological traits relevant to eating disorders (ineffectiveness, perfection, interpersonal distrust, interoceptive awareness, maturity fears). These instruments have not been validated in cross-cultural settings, however.

According to the position of the Society for Adolescent Medicine on eating disorders in adolescents (Kreipe et al, 1995), the threshold for intervention should be lower in adolescents because of potentially irreversible effects on physical and emotional growth and development, as well as risk of death.

4.5.6 Management of severe malnutrition in adolescents, particularly in emergency situations

Severe malnutrition is usually seen as a problem of pre-school age children exclusively. It may also occur as a primary disorder in adolescents and adults in extreme conditions of deprivation and famine, although it is often encountered in association with other illnesses, notably chronic infections, which should be treated at the same time as malnutrition. In emergency situations, the focus on child malnutrition is often responsible for the absence of services tailored towards older children and adults in spite, of their needs. A variety of social groups have been recognized as vulnerable in such circumstances, but adolescents are not usually among these. Moreover, most of the attention is directed at under-five children in targeted programmes.

This may result in population groups over five years of age suffering disproportionately from increased risk during emergencies, as suggested by data sets from refugee camps in Uganda, Tanzania and Zaire (Davis 1996). The high proportion of excess deaths observed among people above five years of age has already been mentioned (section 3.2.1). This is likely so because young children, who are normally at higher risk, are better protected by emergency assistance. Adolescents and adults may be more resilient, but if severe conditions persist, they will succumb unless they are also given access to proper care including therapeutic feeding programmes. In southern Sudan, during the famine year of 1998, supplementary and therapeutic feeding centres only included adolescents and adults on an ad hoc basis, although in many areas, mortality patterns were by the end of the year typical of a late stage of severe famines, with adult and adolescent deaths out-numbering those of under-fives¹⁷. This target group was neglected in Sudan, in spite of the fact that the importance of adult and adolescent malnutrition in famine had been recognized in previous emergency situations and increased attention had been given to adult feeding, including in Somalia (Collins 1993). Many reasons may explain this neglect in Sudan, including inadequate scientific basis for the diagnosis and treatment, and limited experience in managing adolescent (and adult) severe malnutrition, in many ways more complex than that of under-fives.

There is as yet inadequate scientific information on the anthropometric assessment of malnutrition in adolescents (and adults). BMI reference values may not apply to individuals in view of wide variations in body shape and leg length, and corrections at population level using the “Cormic index” (standing height/sitting height) are not practical at an individual level for admission into feeding centres. A median weight-for-height chart derived from NCHS data on height-for-age and weight-for-age for adolescent boys and girls has been developed and is being used by some NGOs in the field¹⁸ with 70% of the median as suggested cut-off point for admission in, and 85% for discharge from, supplementary feeding programmes, as for younger children. While these benchmarks may be useful, their validity needs to be appraised. Arm circumference is another potentially useful indicator in adolescents, but it has not been validated and no cut-off values exist for adolescents. Discharge criteria are also seriously lacking. Much operational research is needed on these issues. Appropriate attention to adolescents’ and adults’ malnutrition in severe famine is vitally important since they are the most economically productive groups, and since rehabilitation is often successful with appropriate care. Many of these people could be saved with some redirection of resources towards adult therapeutic units (Collins 1993).

Notwithstanding the fact that additional research on anthropometric assessment of severe malnutrition in adolescence is warranted, a clinical assessment is sufficient to screen those adolescents in dire need for food supplements without awaiting anthropometric assessment, based on vitality, muscle wasting, ability to walk, etc (WHO 1995a). In the absence of appropriate anthropometric criteria and data, it is difficult, however, to draw decision-makers’ attention to the need for nutritional support of adolescents, where this may be the case. There is at this time an estimated total number of 418 million people who

¹⁷ Salama P, Collins S. An ongoing omission: Adolescent and adult malnutrition in famine situations. Concern, 15/4/99, in: ngonut@abdn.ac.uk, 10/05/99

¹⁸ Golden M, ngonut....2abdn.ac.uk, 22/06/99

are affected by emergencies worldwide¹⁹, and therefore, a large number of adolescents may be at high risk of unattended severe malnutrition.

Guidelines on management of severe malnutrition in children, adolescents and adults has recently been published by WHO (1999c). Basically, treatment of severe malnutrition in adolescents is not considered in this document to be very different from that in younger children, with an initial (or acute) treatment phase with liquid feeds and a rehabilitation phase with progressive integration of traditional solid foods once appetite returns. At variance with children, however, adolescents (or adults) may be reluctant to take the liquid formula feeds in the initial phase of treatment, unless they perceive these as medicine (WHO, *ibid*), or else, they can make the connection between lack of food and their condition. Other differences in the treatment of acute malnutrition in adults and children have been outlined (Collins, 1993). Anorexia may present more of a problem in adolescents or adults, as well as acceptance of nasogastric tubes. Nutritional oedema is often more common and the protein content of the diet more critical in adults.

At this time, the main criteria of severe malnutrition in adolescents are a BMI below the 5th percentile of the reference population for age (WHO 1995a), or the presence of nutritional oedema. Oedema from non-nutritional causes needs to be identified by the history and the medical examination. In adults (or in adolescents having gone through the growth spurt two years before), the BMI cut-off point for undernutrition would be 16, but this represents approximately 20% of body-weight deficit, whereas weight deficits of 40% are common among adults in famines.

The formula feeds are usually based on dried skimmed milk, flour, sugar, vegetable oil and vitamin and mineral mix, and the concentration is increased when moving into the rehabilitation phase (WHO 1999c). Inappropriate management of severe malnutrition may result in complications, and even death, particularly, but not exclusively in young children. With present knowledge and understanding of malnutrition and nutritional requirements, the following errors can be avoided (Moy 1999).

To avoid in management of severe malnutrition (Moy 1999)

- Diets too high in energy and protein given in the acute treatment phase
- Diuretics given to treat nutritional anaemia
- No vitamin A supplements given
- Anaemia treated immediately with iron supplements
- Intravenous albumin or amino acids given
- Broad spectrum antibiotics not given
- Use of high sodium oral rehydration solutions and intravenous fluids
- Failure to monitor food intake
- Lack of feeding at night [particularly in young children]
- Lack of provision of blankets with risk of hypothermia.

4.6 Case management of nutritional problems in health care

4.6.1 *Adolescents with diabetes mellitus*

Type 1 diabetes mellitus is the third most common chronic disease in young people after asthma and cerebral palsy (Betts et al, 1996). The incidence in young people under 16 has increased. To survive, the individual with type 1 diabetes (formerly insulin-dependent diabetes mellitus, IDDM) must take responsibility for the treatment which includes daily insulin administration, monitoring of glucose,

¹⁹ WHO: www.who.int/cha/emergenc 26/05/99

management of diet (including timing of meals and snacks with insulin injections), and monitoring of exercise and physical activity level. Many studies have confirmed that improved metabolic control on the basis of average blood sugar levels is associated with delayed onset and progression of microvascular complications.

The observed decline in blood glucose control during adolescence is a problem (Palta et al, 1996), and it is in part due to reduced self-management (Morris et al, 1997). With the desire for increasing independence in adolescence, there is a tendency to neglect the diet, self-monitoring, and insulin injections (Grey, Cameron and Thurber, 1991). In a cross-sectional study on children and adolescents with type 1 diabetes in 18 developed countries, it was found that only one third of the subjects had satisfactory metabolic control, based on glycosylated hemoglobin (Mortensen and Hougaard, 1997). Poor glycemic control was associated with poorer growth and higher total cholesterol levels during a five-year follow-up of children with type 1 diabetes (Gunczler et al, 1996). A consistent observation is that adolescents from more supportive and cohesive families have a better metabolic control (Burrough et al, 1997). In a study in the USA, it was observed that fostering parent-adolescent teamwork in routine follow-up visits of adolescents with type 1 diabetes sustained shared responsibility for insulin administration and glucose monitoring without increasing diabetes-related family conflicts (Anderson et al, 1999). In their longitudinal study among adolescents with type 1 diabetes, Skinner and Hampson (1998) were able to show that family support was a significant predictor of all self-management measures (dietary self-care, blood glucose monitoring, insulin injections), and that friends' support was also related to dietary self-management. Perceived efficacy of treatment was positively associated with dietary self-management, and it is possible that this belief is strengthened with family support. This study also confirmed the role of peers as primary source of emotional support.). There is however limited information on the role and influence of peers, at a time when friendships develop and peer influence becomes increasingly important.

Adolescents with type 1 diabetes participating in a diabetes education programme in Canada (Anderson 1998) reported that they enjoyed learning, problem-solving, interaction with staff, and support (and time-off from school...). In this study, it was also found that more frequent attendance to clinic appointments and higher level of satisfaction were associated with better metabolic control and lower BMI. However, the small size of the study did not permit to conduct multivariate statistical analyses in order to control for confounding effects, in particular duration of diabetes, age and sex. Nevertheless, it tends to corroborate previous findings of poorer metabolic control in adolescents than in adults, since only 17.5% were found to be in the acceptable range of glycosylated hemoglobin.

With adolescents even more so than with adults with diabetes, group approaches to treatment may be critical. Self-care is the key, in particular, adaptation of eating patterns and peer influence is important. However, the critical mass may not often be reached outside large cities. In Oman, for instance, the yearly incidence rate of type 1 diabetes was recently around 2.5 per 100.000 below age 15 (Soliman et al, 1997).

With increasing obesity, there is evidence of growing incidence of type 2 diabetes (formerly non-insulin-dependent diabetes mellitus, NIDDM) among adolescents in developed countries. A ten-fold increase in the incidence has been reported in an American adolescent population over a decade (Pinhas-Hamiel et al, 1996). This is not documented in developing countries, although in indigenous populations known to have high prevalence rates of type 2 diabetes, the condition is observed at a progressively younger age (Fagot-Campagna et al, 1999). There are indications that African American or Mexican American adolescents may be at higher risk than white Americans (Pinhas-Hamiel et al, 1996; Pinhas-Hamiel and Zeitler, 1997).

Primary health-care providers need to be alerted to adolescents with extreme obesity, hypertension, signs of insulin resistance and a family history of Type 2 diabetes, in addition to main complaints of polyuria, polydipsia and weight loss. Because they may present with ketoacidosis, adolescents with type 2 diabetes may be initially diagnosed as having type 1. Unlike subjects with type 1, those with type 2 diabetes are generally obese or very obese. Furthermore, they can forget about their disease and the

need for sustained self-care for long periods of time without becoming seriously ill (Pinhas-Hamiel and Zeitler, 1997). As adolescents typically find it difficult to plan for the future, on-going education about the importance of good metabolic control is crucial, and motivating them to make the necessary lifestyle changes is challenging. For adolescents with Type 2 diabetes, in particular, treatment is difficult because it is observed that they often are very sedentary and unrestrained eaters, at least in the USA. Specific and sustained education, a strong interaction with the health-care team especially the dietary counsellor, and direct involvement of the family, have been advocated (Pinhas-Hamiel and Zeitler, 1997). The primary aim of nutritional management should be gradual and sustained weight loss for optimal glycemic control and decrease of blood lipids and lipoproteins. The eating plan should be individualized based on lifestyle and diabetes management goals. Attention must also be paid to binge eating, a disorder to which extremely obese adolescents are exposed. Emphasis on physical exercise is vital, and fortunately, exercise tolerance may increase with declining body weight.

The Diabetes Control and Complications Trial (DCCT) tested the intensive therapy approach consisting of individualized glucose targets, frequent adjustments based on capillary blood glucose monitoring, and a team approach, with the overall goal of reaching normal or near normal glycemia. Adolescents (13-17 years of age) represented 15% of the cohort (Brink and Moltz, 1997). The study confirmed that diabetes (type 1 in this instance) was more difficult to control and changes more difficult to sustain in adolescents than in adults. However, it was also shown that many teens can succeed with appropriate knowledge, support and empowerment. A recent report suggested that combined treatment with insulin and insulin-like growth factor 1 (IGF-1) reduced insulin requirement for glycemic control in adolescents with type 1 diabetes, without the lipogenic effect usually associated with the intensive insulin therapy (Thraill et al, 1999)²⁰.

In the USA, the American Diabetes Association (1999) posits medical nutrition therapy (MNT) as integral to total diabetes care and management. Because of the complexity of nutrition issues, it is recommended that a nutritionist [registered dietitian], knowledgeable and skilled in implementing MNT, be the team member providing nutrition care and education. It emphasises the fact that today, there is no “diabetic” diet. *“The recommended diet can only be defined as a nutrition prescription based on assessment and treatment goals and outcomes”*. It is also stated in the position paper that different sets of dietary guidelines, including the national Food Guide Pyramid, may be used by persons with diabetes and their family members to make healthful choices, in line with one of the specific goals of nutritional management of diabetes, that is, improvement of overall health through optimal nutrition. In settings where health-care teams are not available, some adjustments may be made, but it remains crucial that well-trained health-care providers give relevant and sustained guidance and support to adolescents for management of their diet. Nutritional management of diabetes evolves constantly, and long-held views become obsolete. As an example, sucrose and sucrose-containing foods are no longer banned from the diet, and they are compatible with glycemic control in type 1 or type 2 diabetes (American Diabetes Association 1999), but they must be substituted for other carbohydrates in the meal plan.

4.6.2 Adolescents with HIV/AIDS

HIV/AIDS is a dramatic public health problem in most of the developing world. Malnutrition is common in HIV infection, and indeed it was one of the earliest identified complications of AIDS. The principal nutritional issues in HIV infection are the interrelationships between nutritional status and the progression of the disease, and the risk of vertical transmission of HIV through breastfeeding.

Malnutrition may have adverse effects on morbidity, mortality and quality of life, independent of immune dysfunction due to HIV infection itself. Nutritional aspects of HIV in general, and not specifically for adolescents or developing countries, have been reviewed (MacDougall 1997; Friis and Michaelsen, 1998). Unless otherwise stated, the following data are taken from these reviews. The multifactorial nature of

²⁰ Also: Reuter Medical News: Addition of IGF-1 improves control in adolescent diabetics without increasing obesity, <http://diabetes.medscape.com/reuters/prof/07.06/dd07069c.html>, 11/11/99

wasting in HIV is well-established, but reduced food intake associated with anorexia, in particular during episodes of clinical instability, is a major contributor. This may be compounded by hypermetabolism and malabsorption. Resting energy expenditure is increased by 10% in HIV-infected subjects. Nutritional support, notably as food supplements, may contribute to improved quality of life, mental and physical performance, delay of disease progression (and transmission) and improved immune function, but these effects need to be more fully evaluated in well-designed nutritional therapy trials (Kotler 1997). There is evidence coming from Uganda of nutrition-mediated immunomodulation of HIV infection among infected adults. In a study of 22 asymptomatic HIV-infected patients randomly assigned to receive during eight weeks an isocaloric and isoprotein nutritional supplement based on either cow's milk or corn and soy, it was found that both supplements induced weight gain, but that only the milk-based supplement was associated with an improved immune status. In Switzerland, nutritional therapy combined with nutrition counselling resulted after 12 weeks in a decrease in whole body protein turnover in HIV-infected patients. Research has also shown that vitamin A deficiency is common in HIV-infected subjects, and that this deficiency may be linked with more rapid advance of the HIV infection, increased mortality and possibly higher rates of maternal-infant HIV transmission (Semba et al, 1995). Patients with AIDS are often deficient in zinc, as evidenced by reduced biological activity of thymulin. In patients with advanced HIV infection, zinc supplementation may be helpful in delaying the onset of AIDS, as suggested by the stabilization or increase in body weight and increases in CD4+ T cell counts. Dietary supplements of vitamins E and C significantly reduce oxidative stress, and fish oil supplementation prevents the loss of LBM and curbs the production of tumour necrosis factor in HIV-infected patients. In Tanzania, high-dose vitamin A supplementation in school-aged children admitted to hospital for pneumonia (9% of whom testing positive for HIV infection) had a strongly positive effect on mortality compared with placebo, and the effect was particularly marked in HIV-infected children²¹. In a South African study, it was found that HIV/AIDS patients were malnourished, and that those with the lowest CD4+ T cell count also tended to have the poorest anthropometric profile (Dannhauser et al, 1999). More than half the patients had intakes below two thirds of requirements for vitamins C, A, B6, and calcium, iron and zinc. The conclusion was that nutritional supplementation should be considered as it might improve the immune function.

Further evidence of benefit of vitamin and oligo-element supplements in HIV patients is accumulating from observational studies, although there are a few conflicting reports. B-group vitamins, particularly B6, would make a difference in terms of survival, while zinc would have an unfavourable effect according to one study (Tang, Graham and Saah, 1996). There have also been suggestions of benefits of selenium supplements (Constans, Conri and Sergeant, 1999). Multi-micronutrient supplementation may be the most feasible and cost-effective measure for HIV patients in developing countries, considering available suggestive evidence of positive effects on survival, progression and transmission of the disease (Kriis and Michaelsen, 1998).

The findings consistently suggest that early nutrition intervention for ensuring high nutritional quality diets can improve the status of HIV-infected subjects. This most likely also applies to adolescents. However, improving the diet of infected subjects, particularly in adolescents who are seldom considered as a nutritionally vulnerable group, may be difficult to achieve in developing countries when access to food is inadequate to begin with. Nevertheless, HIV-infected adolescents should get the benefit of multiple micronutrient supplements, even if still putative, wherever and whenever such supplements are available (Friis and Michaelsen, 1998).

Nutritional status of HIV-infected subjects should be assessed using the BMI. HIV-related malnutrition is currently defined as non-voluntary loss of 10% of baseline body weight. According to the protocol developed by the American Dietetic Association jointly with Morrisson Health Care (1998), counselling for children and adolescents with HIV should include, beyond efforts to maintain adequate weight through an adequate diet, using safe food and water handling procedures, and participating in regular

²¹ Nutrition Research Update, The Arbor Nutrition Guide, <http://arborcom/frame/66051/u!.html>, 14/05/99

physical activity. This protocol identifies three stages of care for children/adolescents, depending on the presence and severity of signs and symptoms, and guidelines for assessment of each stage are elaborated. However, such guidelines and protocols would be appropriate only for large teaching hospitals, and where resources permit. Nevertheless, basic hygiene precautions with food and water are feasible, and should be part of routine advice to HIV patients generally. It remains that achieving an adequate intake is central to HIV treatment anywhere, which represents even more of a challenge in developing countries, particularly in adolescents. A very practical nutrition guide was developed in Zimbabwe for people with HIV/AIDS (Bijlsma 1997). Health-care providers may find it useful for counselling.

It has been suggested that severely malnourished HIV-infected patients, whether children, adolescents or adults, be treated like other severely malnourished individuals, irrespective of their HIV status²², when resources permit.

Pregnant adolescents with HIV are at particularly high nutritional risk. Whether or not HIV-infected women should be advised to breastfeed or not has been an issue since the transmission of HIV by breast milk was observed in the mid 80s. Safe alternatives to breastfeeding should be considered, based on a mother's right to choose the best methods for feeding her child, according to the United Nations' policy of 1997. This policy is accompanied by a set of guidelines for health-care managers and policy-makers. The previous policy of 1992, which took into consideration infant mortality and malnutrition rates, and access to adequate hygiene, proved inadequate in that it tended to be interpreted as a double standard, whereby women of poor countries should continue to breastfeed while in developed countries, alternatives to breastfeeding were recommended for HIV-infected mothers. According to this rights approach, the health-care provider's role as counsellor is important and challenging, as there is no standard advice that works for everyone (Lhotska 1998). The ultimate decision is in the hands of mothers (WHO 1998f), but it has to be a well-informed decision, and health workers need to help the woman consider all aspects, alternatives and risks in a compassionate way, for this is a very stressful situation for women. Data from an international multicentre study on postnatal mother-to-child transmission of HIV-1 (Leroy et al, 1998) provide evidence, although not conclusive, that it may be appropriate to encourage HIV-positive women to consider the option of breastfeeding initially, and to stop earlier than would be done otherwise. Indeed, the study suggested that four months of breastfeeding would be associated with less risk of transmission than more prolonged breastfeeding. Younger mothers or those with few children were also found to be more likely to transmit HIV through breastfeeding than older or higher parity women in Malawi (Miotti et al, 1999). This suggests that adolescent mothers are at particularly high risk. In a prospective study in South Africa (Coutsoudis et al, 1999a), it was found that exclusive breastfeeding and no breastfeeding carried a similar risk of vertical transmission up to three months of age, whereas mixed feeding resulted in significantly increased risk, which suggests that infant-feeding patterns have an influence. However, further research is required in order for adequate advice to be given to HIV-infected mothers in developing countries, and particularly adolescent mothers.

At this time, there is some evidence that certain micronutrients, vitamin A and selenium in particular, may reduce the risk of vertical HIV transmission to infants (Landers 1996; Friis and Michaelsen, 1998). However, contradictory findings have been reported in the case of vitamin A (Coutsoudis et al, 1999b). More randomized controlled supplementation trials are needed to clarify the role of micronutrients and define appropriate public health intervention measures in this regard for HIV clients. Multiple vitamin supplementation may be a cost-effective intervention to improve birth outcomes in infected women. First results of an important randomized control trial in Tanzania (Fawzi et al, 1998) indicate that multivitamin supplementation of HIV-infected pregnant women reduced by about 40% the risk of low-birth-weight infants, severe preterm birth, and small size for gestational age at birth; T cell counts were also increased. Vitamin A alone did not exert such effects.

²² Golden, MHN, in discussions of the NGO Nutrition Discussion Network, 1998 (www.univ-lille1.fr/pfeda/Ngonut/1998)

What is presently known is that women who became infected after childbirth (while breastfeeding) are more likely to transmit the infection to the suckling infant than those who were infected before delivery, and that women with AIDS are also at higher risk of infecting their child. Risk of transmission is also higher with HIV-1 than HIV-2 (Preble and Piwoz, 1998). What is not well-documented as yet, aside from the effect of maternal micronutrient status on vertical transmission of HIV in general and via breastmilk, is the effect of breastfeeding on the immune system of HIV-infected mothers, and factors that modulate infant vulnerability to HIV transmission through breastmilk. The role of colostrum in HIV transmission also needs to be assessed; it is not known whether colostrum protects the infant or to the contrary, increases the risk. Operational research on the feasibility, cost-effectiveness, sustainability, and quality of interventions to reduce breastfeeding transmission of HIV is also warranted (Preble and Piwoz, 1998).

National policies have been established in a few countries on breastfeeding in HIV-infected mothers, and there are lessons to be learned therefrom. In Thailand, for instance, a policy was initiated in 1993 to discourage breastfeeding among HIV-positive mothers, and to distribute free formula to these women through hospitals. This decision was based on estimations of higher risk of HIV/AIDS than of artificial feeding for babies, considering the health standards in the country. However, programme implementation faced difficulties. In 1997, 1.7% of pregnant women tested positive in the country; in 1998, the budget only allowed providing milk formula free to 10-20% of infected mothers.

4.6.3 Food allergies and intolerances

4.6.3.1 Food allergies

The prevalence of allergies in general, and of adverse reactions to food in particular, is unknown, but it appears to be ever-increasing in western societies. There is mounting evidence of the association of this phenomenon with increasing exposure to pollution, and to pesticide residues in foods (Koren and O'Neill, 1998), as well as with early exposure to foreign dietary proteins, notably cow's milk protein in infants. Indeed, cow's milk is one of the most common allergens in children (Werfel, Cooke and Sampson, 1997). Cow's milk protein is the trigger factor of autoimmune processes (American Academy of Pediatrics 1994), and early ingestion, when breastfeeding is short or nil, has been proposed as a possible initiating factor contributing to insulin-dependent diabetes mellitus, the risk being particularly increased in children genetically susceptible to diabetes (Perez-Bravo et al, 1996). It has been suggested, based on the experience of the last 10 years, that the ready availability and early introduction of highly allergenic foods such as peanuts and other nuts, will only increase the number of individuals developing hypersensitivity to foods (Sampson 1997).

It is estimated that 1.5% of the general population and 5% of under-five children in the USA experience food allergy disorders (Sampson 1997). It is believed that most young infants 'outgrow' their food hypersensitivity, and that even in older children and adults, the sensitivity is likely to subside in one third of the cases after one or two years of avoidance of the offensive food (Sampson 1997). However, those with peanut, nut, shellfish or fish hypersensitivity rarely lose clinical reactivity. Similarly, celiac disease, which is a non-IgE-mediated food hypersensitivity, is a lifelong sensitivity.

'Food allergy' refers to a variety of specific and non-specific symptoms related to ingestion of foods. Food hypersensitivity refers to reactions mediated by the immune system, whether IgE-mediated or not; this type is often described as 'true' food allergies. Food intolerance, the most widespread being lactose from milk, refers to reactions that are not mediated by the immune system (Anderson 1996).

In the Netherlands, self-reported food hypersensitivity was 7.2% among schoolchildren (Brugman et al, 1998). Food additives and chocolate were most frequently avoided. Many studies suggest that food allergy plays a role in the pathogenesis of atopic dermatitis in children. Among those children, approximately one third showed IgE-mediated hypersensitivity to food proteins (Eigenmann et al, 1998). In American children and adolescents evaluated for allergy, all of whom with atopic dermatitis, the prevalence of specific food allergies was found to range from 22% for wheat to 73% for egg (Sampson and Ho, 1997).

Allergy to egg, milk, peanut and soy accounted for 87% of confirmed reactions. Similarly, in another American study, 60% of subjects with atopic dermatitis and ranging in age from 4 months to 22 years had at least one positive prick skin test to various food allergens, and seven foods accounted for most of the positive reactions: milk, egg, peanut, soy, wheat, cod/catfish, cashew (Burks et al, 1998). In children, the most common allergens are cow's milk, eggs, fish, peanut, wheat and soy, and in adults, nuts, shellfish and eggs (Chandra 1997). While young infants commonly present with gastrointestinal problems, older children commonly have skin signs. Angioedema and anaphylaxis may occur at any age (Chandra 1997).

The mainstay of therapy remains the avoidance of incriminated foods, and education to deal with inadvertent exposure (Sampson 1997). Processed foods may hide small quantities of the offensive foods, and affected subjects have to be aware of the need for judicious choice of prepared foods. Regarding prevention in children born to allergic parents, long-term and well-controlled studies do not provide evidence for benefit of a special diet in the mother or the infant, but breastfeeding and avoidance of common food allergens during lactation were reportedly of some benefit in the short term, with high-risk infants experiencing less allergy symptoms (Anderson 1997). However, further studies are required to elucidate the prophylactic role of maternal and infant diets.

4.6.3.2 *Celiac disease*

Celiac disease results from a genetically-based immunological intolerance to ingested gluten, and it differs from traditional IgE-mediated food allergies in that a chronic inflammatory response is induced in the small-intestinal mucosa, the primary site of the damage. It is not common in the USA, although it may be underdiagnosed. It is detected more often among women than men, and the age at diagnosis varies dramatically. It is common in many different ethnic groups in Europe, including Italians, British, Spaniards, in Jews, and in Palestinians. The disease has reportedly been described in South America, Cuba, eastern Europe, the Near East, and North Africa (Murray 1999). It rarely occurs in Black and Asian populations (Halsted 1996). The diagnosis rests on the histological confirmation of the intestinal lesion, but signs include steatorrhea, weight loss, malnutrition, and improvement after the removal of gluten (wheat) from the diet. The treatment consists of a gluten-free diet, that is, containing no wheat, rye, barley, and oats. Regarding oats, it may not be toxic to celiacs, but there is ongoing research to confirm this. Caution needs to be exerted when choosing processed foods, which may hide the offending allergens.

4.6.3.3 *Lactose intolerance*

Lactose intolerance or maldigestion does not involve an immunological reaction, and it has to be clearly distinguished from allergy to milk protein. It is the most common type of food intolerance, due to lactase deficiency or low activity of the enzyme. Primary lactase deficiency occurs as a normal physiological process that occurs in people between the age of two and 20 years (McBean and Miller, 1998). The majority of non-Caucasians have low lactase activity beyond infancy (unless milk is a dietary staple, like in herders), and may experience colics, diarrhoea or flatulence after consuming moderate to large amounts of lactose-containing dairy products. However, most people are able to eat reasonable amounts without any discomfort, and tolerance tends to increase with consumption (Vesa, Korpela and Sahi, 1996). Lactose intolerance is most likely less common than presently claimed, in the USA for instance (Suarez et al, 1997). Fermented milk and cheeses have a much-reduced lactose content, and they are therefore very well tolerated by milk-intolerant people, so that lactose maldigestion is not incompatible with a liberal intake of calcium from conventional dairy products (Suarez et al, 1998). However, in populations who normally consume large amounts of milk products, and who experience a high rate of osteoporosis at older age, lactose intolerance may be a factor for osteoporosis (Lee and Krasinski, 1998), even in young adults (Teesalu, Vihalemm and Vaasa, 1996), and calcium supplementation has been suggested (Srinivasan and Minocha, 1998). Nevertheless, since osteoporosis is relatively less important in developing countries and in non-Caucasian people (Scrimgeour 1992; Bertron, Barnard and Mills, 1999), there is little evidence that dairy products have an effect on osteoporosis in these population groups, and therefore, calcium supplementation would not be justified.

Lactose intolerance may be secondary to intestinal brush border alterations in association with infection of malnutrition. It has also been observed in HIV infection, and the degree of lactose intolerance was higher in symptomatic patients (Corazza et al, 1997).

4.6.3.4 Other: hyperlipidemia; sickle cell anaemia

In the USA, the National Cholesterol Education Program (1991) published a report to address the importance of lowering serum cholesterol among children and adolescents. It underscores the role of high cholesterol in childhood for the development of atherosclerosis in adulthood. A dual approach is recommended: 1) population-based strategy aimed at reducing average cholesterol levels, which includes children from 2-3 years onwards, and focuses on low saturated fat and low-cholesterol eating patterns in families; 2) selective screening and individual approach of children at high risk, with diet therapy and physical activity.

A cholesterol-lowering therapeutic diet was tested for its safety and efficacy among growing children (2-15 years of age) with severe hyperlipidemia (total cholesterol >95th percentile for age) in New York (Jacobson et al, 1998). It was found that while effective in improving in a sustainable manner the serum lipid profile, a fat-controlled diet under supervision (<30% of total calories as fat; 10% as saturated fat; 100 mg cholesterol/1000kcal) did not affect growth. In the Bogalusa study in Louisiana, it had been reported that unsupervised low-fat diets tended to be associated in children with inadequate micronutrient intake (Nicklas et al, 1992), which could compromise growth. In the present study, the therapeutic diet was supervised by dietitians. A nutrition care plan was formulated to achieve the NCEP (National Cholesterol Education Program) step 1 diet. Micronutrient and energy adequacy was stressed. It therefore appears that control of fat intake may be effective, but that it requires supervision.

Growth retardation and delayed puberty are commonly seen in children with sickle-cell anaemia. This may be attributable to several factors: inadequate energy intake, micronutrient deficiencies, elevated metabolic needs, malabsorption and increased nutrient losses. There is no conclusive evidence that micronutrient deficiencies are implicated. However, metabolic rate is increased, which implies that dietary intakes may be inadequate (Kopp-Hoolihan et al, 1999). In such cases, adolescents should benefit from personalized counselling, based on a careful dietary assessment, with suggested ways of achieving an adequate intake and a sufficiently diversified diet.

4.7 Synthesis: good practices for health-care providers to attend to the nutrition needs of adolescents

Suggested good practices for health-care providers, based on reviewed evidence, are summarized in Chart 1.

Whilst health-care facilities are more appropriate for some of the suggested activities (eg, individual nutritional assessment; detection and treatment of micronutrient deficiencies, management of severe undernutrition; antenatal nutritional care; nutritional management of diabetes and other clinical conditions), other settings are better suited for promotional and preventive types of action, because groups are reached (schools, youth groups...), or because the issues require collaboration with other sectors (for instance, food security problems, whether supply or access or both are involved). It is only reminded here that nutrition is about food to begin with, and that if malnutrition has health consequences, it has non-health causes in most instances, particularly among adolescents.

Chart 1: Nutrition Intervention – Dealing with Adolescents

<i>HOW NO LONGER A CHILD</i>	<i>HOW NOT YET AN ADULT</i>
Physiological Characteristics	
<ul style="list-style-type: none"> • Less morbidity ⇓ <i>Not seen as high priority group for health and nutrition</i> • Puberty ⇓ <i>Iron losses in girls</i> 	<ul style="list-style-type: none"> • Still growing ⇓ <i>High nutritional requirements</i> <i>Anthropometric assessment issues</i> <i>Catch-up growth?</i> • Girls not quite ready for pregnancy ⇓ <i>Time to prepare for it</i> <i>Risks of early pregnancy</i> • Little affected by chronic disease ⇓ <i>Good time for prevention</i>
Psychological Characteristics	
<ul style="list-style-type: none"> • Striving for autonomy ⇓ <i>Need for empowering approaches</i> • Curious, experiential, influenced by media ⇓ <i>Good target group for social marketing and promotional activities</i> • Increasing influence of peers ⇓ <i>Group initiatives, peer-led education</i> • Body conscious (more so for girls) ⇓ <i>Over- dieting and risk of eating disturbances</i> 	<ul style="list-style-type: none"> • Not set in their ways ⇓ <i>Good time for shaping or consolidating food habits and lifestyles</i> • Risk behaviours; not much concern for health ⇓ <i>Motivations other than prevention of disease for healthy behaviours</i> <i>Address together eating and health behaviours</i> <i>Connect healthy eating with THEIR values</i> • Limited self-esteem and confidence ⇓ <i>Less attendance at clinics</i> <i>Need for confidential health services</i> <i>Pregnancy sought for sense of self-worth</i> <i>Risk of eating disturbances</i>

HOW NO LONGER A CHILD	HOW NOT YET AN ADULT
Social, livelihood/lifestyle characteristics	
<ul style="list-style-type: none"> Less “care” from adults ⇓ <i>Choose what they eat</i> <i>Many meals, snacks away from home</i> No time to eat ⇓ <i>Much snacking</i> Peer activities ⇓ <i>Peer group- based programmes</i> Less physically active ⇓ <i>More risk of overweight</i> <p>OR:</p> <ul style="list-style-type: none"> Heavy physical work ⇓ <i>Increased energy needs and risk of undernutrition</i> 	<p>Usually still in school ⇓ <i>School-based programmes</i></p> <p>BUT:</p> <ul style="list-style-type: none"> Poorer groups not in school; early work and family responsibilities ⇓ <i>Harder to reach</i> <i>Role in community</i> <i>Lack of access to food as an obstacle to nutrition</i> Less resources than adults ⇓ <i>May limit food choices</i>

CONCLUSIONS AND RECOMMENDATIONS

5.1 Adolescents are vulnerable and deserve special attention in nutrition

This review highlighted particular issues, challenges and opportunities in adolescent nutrition that would deserve more attention than granted up to now. Adolescents are a somewhat neglected group although they are nutritionally vulnerable in many ways, the most plausible reason being that they are relatively healthy compared to younger children (and ageing adults). They tend to be neglected in developed and developing countries alike, except perhaps for early pregnancy and STDs. In developing countries, under-fives and pregnant women are the main focus, and even school-age children are often somewhat neglected. In developed countries, there is a great deal of emphasis on ageing. Adolescents' lifestyle and eating patterns, while given some attention in view of increasing obesity and eating disturbances, are not top of the priority list. Adolescence is a transitional period between childhood and adulthood with specific physiological, psychological and social features that have a bearing on nutrition problems and intervention strategies. The implications, based on the review, are summarized in Chart 2.

Dichotomizing the nutrition problems of industrialized versus developing countries is becoming more irrelevant, particularly for adolescents. In developed countries, new forms of food poverty and poor nutrition are observed, linked with growing social inequities and marginalization. In developing countries, western lifestyles and eating patterns are spreading, bringing with them nutrition-related problems. Furthermore, 'developing countries' are a diverse group, and the main nutrition issues are likely similar for the majority of adolescents in countries in transition or in rapidly developing economies, for the more affluent in poor countries, and for adolescents of industrialized countries.

It is emphasized that not only nutrition interventions per se may have a positive nutritional impact. Health-care activities in reproductive health, for instance, are vital for delaying the first pregnancy, which contributes to reduced parity, as well as for spacing pregnancies, notably with the help of exclusive breastfeeding in the first six months, all important factors of nutritional improvement at all stages of the life-cycle, not only in adolescence. Prevention and control of infections also contribute in a substantive manner to nutritional improvement. Infections and infestations may impair food intake due to anorexia, accelerate body utilization of nutrients because of hypermetabolism, and entail nutrient losses to parasites or through malabsorption. It is now well-established, for instance, that infections alter vitamin A and iron status, which in turn affect resistance to infection. All these health interventions will have even more impact if linked with appropriate nutritional advice and support, which calls for heightened nutrition awareness amongst health professionals and field workers.

Adolescents can be reached with younger children in schools, and with adults, for instance in prenatal care in the case of pregnant girls. Although resources may not allow special programmes, specific approaches are needed. For instance in school programmes, which are so crucial for health and nutrition promotion, the fact that adolescents have (and seek) more independence is an important consideration. In health-care settings, prenatal care for adolescents must take into account their usually lower level of self-confidence than adult women.

Chart II: Nutrition of Adolescents – Suggested Practices for Health-Care Providers		
ACTION	SPECIFICS	COMMENTS
A. Promotion of nutrition integrated in health promotion: 1) Use every opportunity with individuals and groups 2) In schools, communities, worksites, health centres... 3) Focus on promoting: <ul style="list-style-type: none"> - Healthy eating - Physical activity - Breastfeeding - Self-esteem 	Promotion through: <ol style="list-style-type: none"> 1) Building skills 2) Developing healthy attitudes 3) Encouraging healthy behaviours <ul style="list-style-type: none"> - For healthy eating, food focus: <ol style="list-style-type: none"> 1) Reference to dietary guidelines 2) Emphasis on: fruits, vegetables, whole grains, legumes, little animal fat and refined sugar 3) Increasing skills in food choice, handling and preparation 	Also need to be improved as part of nutrition promotion: <ul style="list-style-type: none"> - Food security - Nutrition services and access to them
	B. Nutritional assessment: 1) Anthropometry, at every opportunity 2) Systematic dietary inquiry <u>IF</u> : <ul style="list-style-type: none"> - Too low or too high BMI - Pregnancy - Micronutrient deficiency suspected - Diabetes - Food allergy/intolerance suspected 3) Clinical signs of deficiencies to be alerted to, depending on context	<ul style="list-style-type: none"> - Undernutrition if BMI < 5th percentile: <ul style="list-style-type: none"> → check for underlying disease, food insecurity, anaemia and other deficiency signs, eating disturbances - Overweight if BMI > 85th percentile: <ul style="list-style-type: none"> → Confirm obesity, but cautious interpretation of skinfolds → Assess risk from family history (and biological tests) CAUTIOUS INTERPRETATION For pregnant adolescents: see 'Antenatal care'

ACTION	SPECIFICS	COMMENTS
<p>C. Control of micronutrient deficiencies (iron, iodine, vitamin A in particular)</p> <ol style="list-style-type: none"> 1) Check for clinical (and other) signs 2) Treat deficiencies according to established protocols 3) Check for dietary inadequacies (vitamin A and iron in particular) <p>Prevention: see specifics</p> <p>Iron deficiency and anaemia:</p>	<ul style="list-style-type: none"> - No need to screen before supplementing if anaemia rate $\geq 30\%$ - Consider weekly supplementation for girls, <i>via</i> schools and other routes - Emphasise dietary measures, eg, increasing intake of vitamin C containing foods - Emphasise sanitation, hygiene (in addition to deworming) - Combine with vitamin A measures if deficiency suspected <p>Iodine deficiency:</p> <ul style="list-style-type: none"> - In endemic areas, adolescent girls as high priority group for supplementation if iodised salt (or water) not available or accessible - Oral iodised oil yearly (or potassium iodate solution more frequently) <p>Vitamin A deficiency:</p> <ul style="list-style-type: none"> - Focus on food-based approaches: <ol style="list-style-type: none"> 1) Consumption of available plant and animal food sources 2) Consider food production, marketing, processing approaches <p>Mind other deficiency signs</p>	<ul style="list-style-type: none"> - Multiple deficiencies common <ul style="list-style-type: none"> → strategies: <ol style="list-style-type: none"> 1) to enhance overall nutritional quality of diet 2) multiple micronutrient fortification 3) multiple supplementation - Fortified foods may reach more adolescents than supplements - Control of infection, parasites and helminths will go a long way to improve micronutrient nutrition - Breastfeeding promotion is an essential component of micronutrient strategies - Health sector to collaborate with agriculture for interventions involving the food system (production, marketing, processing...)

ACTION	SPECIFICS	COMMENTS
<p>D. Nutrition in antenatal (and postnatal) care for adolescents:</p> <ol style="list-style-type: none"> 1) All pregnant adolescents to be considered at high nutritional risk 2) Dietary advice to be given at each visit 3) Priority to pregnant or lactating adolescents for food supplementation (if appropriate) 4) Nutrition particularly important in postnatal care of adolescent mothers 	<ul style="list-style-type: none"> - Monitor weight gain. If inadequate (<25th percentile): <ol style="list-style-type: none"> 1) Investigate for causes 2) Dietary counselling based on inquiry 3) Food supplements if needed - Micronutrient supplements: <ol style="list-style-type: none"> 1) Iron/folate: as in adults 2) Iodine: supplement <u>early</u> if no iodised salt or water and deficiency endemic 3) If vitamin A deficiency in area, check for nightblindness, advise on food, and supplement if policy - Follow-up in postpartum: <ol style="list-style-type: none"> 1) Check weight, to return to pre-pregnancy normal in 6 months 2) Check and advise on diet 3) Give support for breastfeeding - Micronutrient supplementation where needed 	<ul style="list-style-type: none"> - At still higher risk: <ol style="list-style-type: none"> 1) Younger adolescents (<2 years —since menarche) 2) Primiparae 3) Those with low body weight at onset of pregnancy or short stature - Adequate weight gain even more critical than in adults - More emphasis on one-to-one nutritional counselling than with adults - Calcium supplementation if risk of pre-eclampsia (?)
<p>E. (Prevention and) Management of malnutrition in adolescence</p> <ul style="list-style-type: none"> - Adolescent malnutrition not to be neglected 	<ul style="list-style-type: none"> - Treat underlying disease - In emergency settings, screening of severely malnourished adolescents (BMI < 5th percentile + physical signs) - Treatment of severe malnutrition: like in children, but encouragement needed to accept fluid feeds 	<ul style="list-style-type: none"> - In long term food crisis situations, adolescents should be one priority group for therapeutic nutrition - Adolescent malnutrition (if not secondary to disease) best prevented by anti-poverty measures and food security and development projects: health care providers to collaborate

ACTION	SPECIFICS	COMMENTS
F. Prevention (and management) of obesity, and of eating disturbances: <ol style="list-style-type: none"> Prevention as a priority in adolescence everywhere Schools are appropriate settings for prevention and referral 	<ul style="list-style-type: none"> - See 'Nutrition promotion' for prevention strategies - Weight reduction programme for subjects with co-morbidity or family risk factors: <ol style="list-style-type: none"> 1) Healthy eating more than dieting 2) Physical activity important 3) Individual counselling + group approaches relevant - Detect risk of dietary disturbances: <ol style="list-style-type: none"> 1) Early clinical sign: unexplained weight loss (2 BMI points or 10% of previous weight) 2) Poor body image 3) Extreme weight loss measures - For treatment: health care team 	<ul style="list-style-type: none"> - Obesity should not be over-emphasised in order not to encourage over-dieting and eating disturbances - Girls are the primary target for prevention of eating disturbances, even at pre-adolescence
G. Diabetes in adolescents:	<ul style="list-style-type: none"> - Standard clinical signs, but ketoacidosis may be present, even if Type 2 diabetes - Glycemic control and self care often poor in adolescents - Peer and family support important - In Type 1, eating plan to be defined by dietitian with individual and MD - In Type 2 diabetes: <ol style="list-style-type: none"> 1) Weight control usually central 2) Healthy eating rather than dieting, cautious use of sugars 	<p>With increasing obesity, diabetes is also increasing in young people</p>
H. HIV/AIDS:	<p>Malnutrition:</p> <ul style="list-style-type: none"> - Common. If severe malnutrition: standard treatment - For optimal nutrition: <ol style="list-style-type: none"> 1) Adequate intake, healthy eating 2) Food hygiene and safe water 3) Physical activity 4) Multiple vitamin and mineral supplements if available 	<ul style="list-style-type: none"> - Nutritional status related to progression of disease - Nutrition further compromised in pregnant HIV-infected adolescents

ACTION	SPECIFICS	COMMENTS
	<p>Breastfeeding and HIV transmission:</p> <ul style="list-style-type: none"> - Pregnant adolescents must be well informed of risks and advantages to decide - May be advised to <u>exclusively</u> breastfeed, and for a short period (4 months) 	<ul style="list-style-type: none"> - Maternal nutritional status, and infant feeding practices, may influence HIV transmission via breastmilk
<p>I. Other conditions:</p> <ol style="list-style-type: none"> 1) Allergies, intolerances: avoid/limit incriminated foods 2) Other clinical conditions compromising nutrition (and growth and development): → Goal: adequate intake, based on healthy eating principles 	<p>Allergies, intolerances:</p> <ul style="list-style-type: none"> - Allergies mainly to protein fi identify the offensive foods - Milk intolerance (lactose deficiency): <ol style="list-style-type: none"> 1) Moderate (but variable) amounts of dairy products tolerated 2) Calcium nutriture not affected <p>Other clinical conditions:</p> <ul style="list-style-type: none"> - Adequate nutrition compromised if: <ol style="list-style-type: none"> 1) anorexia 2) hypermetabolism 3) nutrient losses. 	<ul style="list-style-type: none"> - Food intolerance is not necessarily an allergy - Adolescents may have less allergies than younger children - Lactose deficiency more frequent in adolescents than children (non- Caucasians essentially)

5.2 Need for inclusive strategies and specific policies for adolescent nutrition at country level

Key questions addressed in this working document were whether there is evidence to show that adolescents as a group require particular focus for nutrition action, whether their nutrition-related needs are adequately addressed, and what approaches/actions are to be recommended. If asked whether enough is

done for adolescent nutrition, a legitimate answer could be: we could do better.

It is concluded that adolescents are a nutritionally vulnerable group in many ways (perhaps the third, behind pre-schoolers and mothers), and that unless there are explicit policies and priorities for adolescent nutrition at country level, key issues may not be adequately addressed, and in particular, large groups of adolescents may be missed. With such nutrition policies, school-nutrition and adolescent pregnancy nutrition programmes would partly overlap, but far from being a problem, this would ensure a complete and fully integrated approach. There are examples of a nutrition policy for adolescents even in the USA. WHO should provide support to countries to develop their policy on adolescent nutrition, to define priorities and to integrate nutrition concerns into existing programmes reaching adolescents. While specific policies are indispensable for adolescent nutrition needs to be properly addressed, it is our view that there is no need for separate programmes for adolescent nutrition.

5.3 Evidence-based strategic orientations

Because adolescents are a diverse group, because they, more than any other age group, are simultaneously exposed to nutritional problems traditionally associated with deprivation and affluence, and because their nutrition is a major determinant of the society's future health, they require specific attention, and in a specific way (although within existing programmes), in order for nutrition activities to be congruent with their physiological, psychological and social needs. In the realm of health care, it is our firm belief that efforts directed at adolescents will contribute to achieving nutrition objectives and strategies as defined at the International Conference on Nutrition (FAO/WHO 1992), and reiterated since. Nutritional intervention, however, is difficult because it usually requires time, as it is usually about changing human behaviour.

Priorities are only briefly described below. Programme components are detailed in Chapter 4.

5.3.1 *Caveat on 'evidence-based' decision-making and planning*

In nutrition as in other areas, quick fixes exist and they are tempting because of short-term, sometimes even spectacular results (but of questionable sustainability) that can be presented to decision-makers, funding agencies and political constituencies. Evidence-based decision-making and planning may further encourage short-term approaches to nutritional problems, because there is more evidence of impact and cost-effectiveness in the case of clean-cut interventions such as micronutrient supplementation, than when dealing with more complex programmes involving behavioural changes in food production, processing, distribution and consumption, and with likely impact not only on nutritional health, but also on income and other elements of livelihood systems. Although the advocated priorities are based upon near consensus about the importance of the problem and scientific evidence of the relevance of the approach, recommendations cannot always be based on demonstrated impact and cost-effectiveness, owing both to the long-range nutritional effects, and on the paucity of operational research in nutrition, and particularly so in adolescents. Nevertheless, there are encouraging data on the prevention of chronic disease through nutrition, notably obesity and cardiovascular disease. It has been estimated, for example, that the prevention of age-related rise in blood cholesterol by 1 mmol/l would correspond, in 45 year-old men, to roughly 40% fewer deaths, and 20% before age 60 (Westlund 1998).

5.3.2 Primary focus on nutrition promotion, the key role of schools, and the importance of dietary guidelines

The health-promotion approach allows the integration of all determinants of health and aims at empowering people, two features that make it particularly appropriate for addressing nutrition in adolescents. Forms of action recommended in health promotion are building public-health policy, creating supportive environment, strengthening community action, developing personal skills for healthy lifestyles and reorienting health services. Applying these to nutrition: advocacy for specifically addressing adolescents' nutrition issues is part of building public health policy; adequate food supply and access to it, that is food security, is critical for a supportive environment to good nutrition; community action can be strengthened through school-based nutrition programmes, and youth-group and other community-based initiatives designed not only to promote nutrition, but also to address other development needs of adolescents; developing personal skills may encompass strengthening abilities in choosing, producing or purchasing and preparing foods, as well as consumer information, for boys as for girls; finally, more emphasis of health-care providers on nutritional and dietary assessment of adolescents wherever they can be reached, for surveillance and for relevant action, would appear as a potentially effective reorientation in health-care services.

Nutrition education, food security and access to nutrition services are then the three major components of nutrition promotion. In accordance with its mandate, the health-care sector is primarily involved in providing nutrition education and services, but health workers have to be aware of food security issues and link with food security programmes. Food security (supply of, and access to enough, nutritious, safe and culturally acceptable food) is a critical environmental determinant of nutritional health. It is only in the extent that people have access to food and some margin for choice that nutrition education can be meaningful.

There is now sufficient evidence to show the deleterious consequences of too much (or too little) food, too much fat, not enough fibre, fruit and vegetables to take action when preventive changes are still possible. This is the rationale for the emphasis on healthy-eating promotion in adolescents. When specific nutrients are lacking from the diet, it is reasonable to consider supplements (unless it is a problem of access to food, in which case food security is the predominant concern), although food-based sustainable approaches are an important part of strategies. However, there is no pharmaceutical approach to eating too much, or to an unbalanced diet. Furthermore, foods do not merely consist in mixtures of nutrients, and some phytochemicals begin to reveal their health benefits. Therefore, promotion of nutrition rests to a large extent upon healthy eating, and behavioural changes to this end.

Nutrition education is challenging and appropriate tools are not always available. Among these, site- and culture-specific dietary guidelines are particularly useful, and efforts should be devoted to using them where available, or to advocate for their development where they do not yet exist. Adolescents do not need specific sets of dietary guidelines.

Cultural modelling is being considered as a novel approach to nutrition communication (Milio and Helsing, 1998) whereby dietary advice is based on known food patterns in populations enjoying above-average health. The traditional Mediterranean diet is an example of cultural modelling, and the Mediterranean diet pyramid is the corresponding food-based guideline set. Contrary to current dietary guidelines, the starting point for the process of developing these guidelines would not be theoretical nutritional recommendations, but rather, the outcome of natural experiments involving different dietary patterns, and associated with exceptionally healthy populations. The Mediterranean diet is but one example, and it can quite easily be transferred to other parts of the world, notably in developed countries. There are undoubtedly other eating patterns associated with more than average health, and that would be appropriate in different ecological settings. It is all a matter of identifying them... and using them in nutrition education of adolescents to begin with, while their habits are being consolidated.

Inconsistent and contradictory information is a problem. In the UK, a survey among 16-19 year-old people revealed a high degree of cynicism about health experts, with 62% agreeing with the statement:

“Experts never agree which foods are good for you”, and only 8% disagreeing (Beishon 1998). Actually, it may not be so much that experts disagree among themselves, but that the information given to consumers is misleading, or inadequate, or inconsistent among sources. For instance, nutritional labels and claims are reportedly used by consumers, but the level of understanding is usually very poor (National Institute of Nutrition, 1997). Adolescents could very well be encouraged to be active (and vocal) members of consumer associations.

The health-promoting school programme is the ideal framework for promoting good nutrition in adolescence. However, means of reaching adolescents who are no longer in school have to be sought, as these young people may be particularly vulnerable because of poverty and other forms of marginalization. Besides, contacts with the health system are scarce during adolescence outside of pregnancy or illness. All opportunities for contact with adolescents for health and nutrition promotion have to be taken advantage of, and some also have to be created, in keeping with an ecological approach to nutrition. Schools may have outreach programmes, such as child-to-child schemes. Youth groups, or other community-based groups with a good proportion of adolescent members, would also appear as promising channels, although evidence of their effectiveness is still needed. For impersonal communication, the mass media are particularly important, as they are very popular among adolescents.

Health and nutrition promotion should not mean, or lead to, healthism. Health is an asset, it is not a religion nor the ultimate aim of life. In industrialized countries, the fascination for health has reached unprecedented levels. New risks and hazards are constantly conveyed to the public through the media (the risk epidemic, according to Førde (1998) so that people can take responsibility for their own health through behavioural change. Epidemiology, it is contended, has had so far a greater influence on our way of eating, acting, living, than any other science or technology (Førde 1998), and overemphasis and overreaction to health risks may be a society problem. One harmful side-effect is that in spite of dramatic improvements in collective health, well-being and satisfaction with personal health are declining, as revealed by surveys in the USA. It has also been suggested that (over)emphasis on healthy lifestyles has led to the increased peril of tyranny of health (Fitzgerald 1994). Health should also mean the ability to cope with ‘unwellness’ in a competent way, and it is argued that the more medicine and society direct individual behaviour, the less autonomous the individual may become (Fitzgerald 1994). Obsession with health and tyranny of health appear to be typical trends of industrialized countries, not only the USA. This risk culture, nurtured by epidemiologists and health promoters, may threaten values such as conviviality, sharing, tolerance, and sociability (Førde, *ibid*). We strongly believe that health and nutrition promotion among adolescents, who are in many ways in the vanguard of society, should stay away from this cultural trend of moral crusade, particularly in developing countries. As adolescents show less concern with their health than adults, they may be less sensitive to health arguments to undertake changes. The opportunity is thereby provided to associate ‘healthy’ behaviours, particularly in the area of food, with other values such as friendship, the family, psychological wellness, self-satisfaction and, why not, pleasure.

Notwithstanding the above, behavioural modification (or consolidation) is often justified, and is the goal of nutrition education. Persuasive approaches have to be developed, and powerful motivators in adolescents may be, as just mentioned, pleasure, self-satisfaction, and overall well-being.

It is seen in the proposed strategic model for addressing nutrition needs of adolescents (Fig. 2) that nutrition promotion not only includes healthy eating, but also the promotion of breastfeeding, of physical activity and of self-esteem. There is now sufficient evidence of the link between lack of self-esteem or sense of worth and distortions of body image and unhealthy eating practices to warrant more emphasis on strengthening self-esteem in adolescents, particularly in girls.

5.3.3 Adolescent girls as a priority target group, before the first pregnancy

The emphasis on women is not an innovative strategy for nutrition in developing countries, except that girls should be reached early enough to delay the first pregnancy and get ready for it nutritionally, rather than focus primarily on pregnant adolescents as a priority group health- and nutrition-wise. Postponing

pregnancy after adolescence is unanimously recognized as the most effective strategy not only for health, but also for sustaining their education.

Iron deficiency and anaemia are widespread in adolescent girls, and should be controlled ahead of pregnancy. Viteri (1997) supports the concept of preventive supplementation to cover the whole reproductive cycle, from pre-pregnancy to at least the end of lactation. It may also promote growth during the adolescent growth spurt, and it certainly contributes to enhance work productivity.

Weekly distribution of iron/folate supplements (or multiple micronutrient supplements) via various routes, youth groups included, is reportedly effective and appropriate outside of pregnancy. Multiple micronutrient-fortified snacks (including iron) are also of potential interest, since adolescents love snacks, and multiple fortification may even be more interesting, as experienced in South Africa (van Stuijvenberg et al, 1999).

It is widely recognized that women's health interventions are highly cost-effective. According to the World Bank, improving health care for women aged 15-44 offers the biggest return on health-care spending for any demographic group of adults (men or women) and furthermore, there are multiple payoffs, in terms of well-being and productivity of women, and significant benefits for families, communities, and national economies²³. Included in the package of essential services for women developed for the World Bank (1993) was the promotion of positive health practices, with adequate nutrition as an explicit component. In its expanded package, nutrition assistance before (and beyond) reproductive age is now advocated by the World Bank.

Building self-esteem and promoting breastfeeding are other important aspects of nutrition action focusing specifically on adolescent girls. Building self-esteem, in the light of programme experience in industrialized countries, is crucial for young girls to develop a 'healthy' body image and stay away from distorted dieting practices, and possibly also to delay pregnancy. This may appear irrelevant considering the relatively higher importance of undernutrition than obesity at this time in many developing countries. However, preventing the obesity epidemic is timely, and adolescents are the key, particularly in urban areas, and through schools.

5.3.4 More of an integrated and food-based approach to micronutrient malnutrition

Regarding the most widespread micronutrient deficiencies, that is iron, vitamin A and iodine deficiencies, each requires a different outlook, while keeping in mind that adolescent girls are a high priority group for remedial measures, and that other deficiencies may be associated. However, in the present state of scientific knowledge, it does not seem indicated to advocate broad-based supplementation or fortification programmes for other micronutrients, although it would be tempting in the case of zinc.

Iodine deficiency is more an ecological than a nutritional problem; salt (or water) iodization is unanimously recognized as the only long-term approach, while supplementation may be indicated as a short-term measure. It is of utmost importance that iodine deficiency in girls be corrected through supplementation before pregnancy, or as early as possible during pregnancy.

In developing countries, anaemia is likely the largest nutritional problem in adolescents (Kurz 1996); it also affects adolescents in developed countries. Iron deficiency is the most widespread form of micronutrient malnutrition, and yet, less well-addressed. It should be a priority area for intervention in adolescents, and it is an investment in future productive and reproductive lives of adolescents. Adolescents need to be included in existing anaemia, and iron (and folate) programmes of the health sector (supplementation; treatment and prevention of hookworms and schistosomiasis), and new strategies to

²³ www.worldbank.org/html/extdr/hnp/health/newagenda/women.htm. A new agenda for women's health and nutrition. Accessed 14/05/99

reach them need to be developed. Enhancing production and consumption of iron-containing foods and of iron absorption-enhancing foods, for instance, vitamin C-containing fresh fruits and vegetables, are in order. Controlling parasitic diseases such as malaria, intestinal helminth, and schistosomiasis will also improve iron status.

However, all these approaches will not suffice in most instances to protect women against iron deficiency anaemia in view of their particularly high requirements and of limited economic access to animal foods providing highly bioavailable iron, and supplementation is needed. Waiting at the time of pregnancy to correct anaemia in women is too late, and a priority intervention should be the control of iron deficiency through dietary measures and appropriate fortification or supplementation schemes in adolescent girls. There is growing evidence that as a preventive strategy at least, weekly iron supplementation may be more cost-effective than daily supplementation, even if it were only because of improved compliance. Another promising avenue is iron-fortified foods, in particularly snack foods frequently consumed by schoolchildren and adolescents (see above).

Vitamin A deficiency is progressively being recognized as a problem not only at preschool and school age, but also of adolescents and adults, particularly women. Whilst supplementation may be essential in the short term, food-based approaches have to be emphasized as long-term sustainable strategies, and they are feasible, unlike iron. In most areas, provitamin A carotenoid-rich fruits and vegetables are plentiful, at least during certain seasons. What is needed is enhanced awareness of the importance of such foods, effort at increasing production, and improved processing methods for optimal provitamin A retention. Bioavailability of provitamin A carotenoids may be much lower than assumed up to recently in the case of, for instance, green leaves, because of the complex vegetable matrix. However, there are other plant foods that provide more bioavailable provitamin A, the vegetable matrix may be broken down through cooking or grinding, and the highest vegetable source of provitamin A, that is unrefined palm oil, is devoid of a vegetable matrix. Deworming and infection control are complementary but necessary approaches to improve vitamin A status, in adolescents as well as in other age groups. There is an opportunity to pilot-test among adolescents the integration of vitamin A food production or processing for income generation with educational components. This type of initiative requires intersectoral collaboration, health and agriculture in particular, which is often a challenge. Youth groups would appear as an appropriate target for programmes designed to increase production and intake of provitamin A-rich foods.

It is important to consider micronutrient malnutrition more globally, as deficiencies are often interconnected, and since there is some evidence that when one deficiency is corrected, another micronutrient may become limiting for nutritional health. The overall nutritional quality of diets, as reflected in the micronutrient mix, should be the target, rather than attempting to correct successively individual micronutrient deficiencies primarily through pharmaceutical supplements, an approach to avoid when not essential, because it is everything but sustainable... and it is endless. Once (and if) the presently addressed micronutrient deficiencies are under control, zinc, selenium, vitamin C and calcium, to name a few, will rise in the priority supplement list. As stated above, the composition of foods is far from fully elucidated and there is growing evidence that components other than well-defined nutrients may play an important and up-to-now unforeseen role in nutritional health.

For more of a food focus, home economists could join the health-care team, and be specifically responsible for building food-related skills among adolescents.

There are major information gaps on the impact of food-based approaches to micronutrient malnutrition, and more evaluation research is direly needed.

5.3.5 The importance of preventing obesity (and eating disturbances)

This is a priority worldwide, as the prevalence of obesity is increasing everywhere. However, this priority would be addressed differently in a population where obesity is already widespread in all segments and in locations where this problem is only observed in upper-income groups. Obesity is associated with

current and future morbidity risks. It is much more difficult to treat than to prevent, and therefore, it appears that early preventive action should be a priority role of health-care providers. Adolescents are a major target group, to be reached primarily through school-based programmes. It is postulated that schools may reach those adolescents at higher risk of obesity and eating disturbances, which are interrelated. Eating disturbances are up to now likely uncommon in developing countries, but unless preventive measures are taken, it is to be feared that they will spread along with the western culture in this world of globalization.

5.4 Research needs

There is a dire need for more research in 'public' nutrition in general, and for research focusing on adolescents in particular. There is a great need not only for research, but also for dissemination of research findings, as well as programme evaluation. Success stories are not many in the published material on those for nutrition, and yet, they are important as a means of spreading best practices in the field.

Intervention rather than observational studies are now needed for progress in effectively addressing nutrition-related needs of adolescents. So little is known on nutrition in adolescence that research needs are tremendous. Many lines of investigation have been suggested throughout the document. They are listed below under specific sub-headings.

5.4.1 On eating behaviours and determinants in adolescents:

A better understanding of adolescents' diets and eating behaviours is essential for relevant education programmes. Additionally, dietary enquiry tools specifically designed for adolescents are direly needed. They should encompass household food security, food diversity (as indicator of nutritional quality), eating practices and underlying influences, and physical activity. These tools need to be developed and validated in different settings, but in the framework of school-based or health centre-based intervention programmes rather than as free-standing research for higher relevance. Participatory approaches are particularly well suited for this type of research work with adolescents. Suggestions of specific research topics are given below:

- Assessment of adolescent eating practices and behaviours as part of health surveys. As an example, in eastern Canada, an adolescent lifestyle questionnaire was developed and tested as a means of measuring healthy lifestyle patterns in adolescents and of assessing the impact of interventions for lifestyle change (Gillis 1997).
- Comprehensive assessment of location-specific factors that influence adolescents' food perceptions and eating behaviours, based perhaps on the social cognitive theory framework (Bandura, 1986).
- Empirical studies to test the effectiveness of different approaches to primary prevention of eating disorders, as well as on factors of vulnerability and of resilience to sociocultural norms overemphasizing thinness.
- Studies to confirm the tracking into adulthood of eating patterns acquired in adolescence.

5.4.2 On nutritional status

- Research on race-specific BMI curves, and on cut-off points for overweight and underweight, to provide appropriate reference data for adolescents.
- Waist-hip ratio and skinfold thickness data also to be collected along with BMI, to serve as reference.

- Studies on calcium, zinc, iron and vitamin A nutrition, and adolescent health:
 - Their relationship with bone mineralization and with the growth spurt in adolescents of different ethnic and socioeconomic groups;
 - The relationship of micronutrient deficiencies with menorrhagia in adolescent girls;
 - The magnitude, causes and significance of transient iron deficiency among adolescent boys;
 - Studies on the importance and contribution of geophagy to micronutrient status of adolescents.
- Respective influence of foetal programming and of ‘social patterning’ on anthropometric status and chronic disease risk markers at adolescence.

5.4.3 On effectiveness of interventions

Much research is still needed to provide a stronger base for effective nutrition management in pregnancy in general and in pregnant adolescents in particular. The scope for catch-up growth in adolescents through nutrition also needs to be elucidated. It will be useful to assess among adolescents (and in schools) food approaches to micronutrient malnutrition, in combination with health measures. Finally, the effectiveness of school-based nutrition promotion with particular focus on prevention of obesity needs to be demonstrated in pilot projects. In addition to cost-effectiveness concerns, evaluation should include process indicators. The following are research topics of particular relevance:

- The effect of food/micronutrient supplementation in pregnant adolescents on maternal and foetal outcomes, and more specifically, on their own growth, and on placental and birth weights.
- The effect of multinutrient dietary improvement (or supplements) on growth and maturation in stunted adolescents, in order to ascertain better the potential for catch-up growth.
- In severely malnourished adolescents: studies on nutritional rehabilitation and discharge criteria.
- Controlled trials on achievable improvements of iron nutrition in adolescents through diet.
- Operational research on pilot projects combining food systems/health approaches to improve vitamin A.
- The impact of school-based nutrition promotion/obesity prevention on eating patterns, attitudes and lifestyles of urban adolescents.

5.5 Recommendations to WHO for priority action and research

Based on this review and subsequent discussions held at WHO, the following are highlighted as potential priorities for WHO’s technical support and research and development.

5.5.1 Technical support

WHO should assist countries to develop sound national policies on adolescent nutrition, to define priority action, to integrate nutritional considerations in programmes directed at adolescents, and to add an adolescent dimension to nutrition programmes where appropriate.

As part of its normative role, WHO should develop or adapt guidelines and tools for the following, even if these are only provisional owing to knowledge gaps:

- For nutritional monitoring and management of pregnancy, in particular in adolescents;
- For anthropometry in schoolchildren and adolescents, with BMI nomograms and cut-off points (in addition to examining the feasibility of routine measurements of heights and weights in schools for surveillance purposes);
- For breastfeeding education among adolescents, and for using generic or locally developed dietary guidelines.

5.5.2 Research priorities

We believe that the following are top research priorities to be addressed by WHO:

- **Adolescent anthropometry:** Multi-country longitudinal and cross-sectional studies on adolescent somatic growth and development, in order to establish international reference data for assessing stunting, undernutrition and overweight in adolescents. Measurements should include weights, heights, circumferences and skinfolds;
- **Micronutrients and growth:** Controlled studies on the impact of micronutrient status/intake/supplements on bone mineralization, the timing and magnitude of the growth spurt, and maturation, in adolescent boys and girls, in particular calcium, zinc, vitamin A and iron;
- **Adolescent pregnancy:** Controlled intervention trials to examine the effect of food supplementation (and micronutrient supplementation) on maternal and foetal outcomes in (high risk) pregnant adolescents, as it is as yet unclear how additional nutrients benefit the mother and the foetus in adolescent pregnancy.

WHO should also stimulate research on adolescents' eating behaviours and underlying influences, and the development of adolescent-specific dietary enquiry tools for the purpose.

Appendix I: Nutritional Status of Adolescents in Developing Countries							
Site of study	Source	Sample	Low BMI ($<5^{\text{th}}$ Percentile) %	Stunting ($<5^{\text{th}}$ Percentile) %	Iron Deficiency Anaemia (Low Hb) %	Iodine Deficiency Disorders %	Other
Bangladesh	WHO Reg. Office SEA (1997)	Girls	78 (<18.5)		74 ($<15\text{y}$)		
Bangladesh	Ahmed et al (1996)	Urban adolescent school girls			22		
Bangladesh	Ahmed et al (1997)	Factory working girls			44		14% low serum retinol ($<0.7 \mu\text{mol/l}$), related to low Hb
Nepal	Kurz and Johnson-Welch (1994)	Girls	25	47 (all)	42		
"	"	Boys	49				
India	Kurz and Johnson-Welch (1994)	Girls	37	45	55 (all)		
"	"	Boys	69	20			
India, poor rural Rajasthan	Chaturvedi et al (1997)	Girls	79 (BMI <16)		74		44% signs of B vitamin deficiencies
Sri Lanka	WHO Reg. Office SEA (1997)	Girls	36-54 (Underweight)	31.5-60		28 (goitre)	
Sri Lanka	Sunathra et al (1993)	School girls 14-18			59 (low iron stores)		
Indonesia	Rainer (1997)	Girls			21		
"	"	Boys			2,5		
Philippines, Cebu	Kurz and Johnson-Welch (1994)	Girls	7	43 (all)			

Site of study	Source	Sample	Low BMI ($<5^{\text{th}}$ Percentile) %	Stunting ($<5^{\text{th}}$ Percentile) %	Iron Deficiency Anaemia (Low Hb) %	Iodine Deficiency Disorders %	Other
"	"	Boys	19				
Benin	Kurz and Johnson-Welch (1994)	Girls	14	27			
"	"	Boys	32	55			
Cameroon	Kurz and Johnson-Welch (1994)	Girls	2	8	32 (all)		
"	"	Boys	8	19			
Nigeria	Adedoyin et al (1989)	Pregnant girls			60		
"	"	Girls			15		
Nigeria	Brabin et al (1997)	Rural girls		10 ($<2^{\text{nd}}$ P.)			
"	"	Urban girls		5 ($<2^{\text{nd}}$ P.)			
Malawi	Fazio-Tirrozzo et al (1998)	Rural adolescent girls	40 ($<2^{\text{nd}}$ P.)	40 ($<2^{\text{nd}}$ P.)	89 (!)		27% low serum retinol ($<0.7 \mu\text{mol/l}$), 40% low vitamin A stores based on MRDR
"	"	Rural pregnant adolescents					74% low serum retinol
Mexico	Kurz and Johnson-Welch (1994)	Boys and girls	3	62			
Guatemala (longitudinal)	Kurz and Johnson-Welch (1994)	Girls	4	57	5		
Guatemala (metabolic)	"	Girls	6	27	48		

Appendix II: Selected Percentiles of Waist Circumference by Race, Sex, and Age

Age (y)	White boys			White girls			Black boys			Black girls		
	<i>n</i>	50 th	90 th	<i>n</i>	50 th	90 th	<i>n</i>	50 th	90 th	<i>n</i>	50 th	90 th
		<i>cm</i>			<i>cm</i>			<i>cm</i>			<i>cm</i>	
5	28	52	59	34	51	57	36	52	56	34	52	56
6	44	54	61	60	53	60	42	54	60	52	53	59
7	54	55	61	55	54	64	53	56	61	52	56	67
8	95	59	75	75	58	73	54	58	67	54	58	65
9	53	62	77	84	60	73	53	60	74	56	61	78
10	72	64	88	67	63	75	53	64	79	49	62	79
11	97	68	90	95	66	83	58	64	79	67	67	87
12	102	70	89	89	67	83	60	68	87	73	67	84
13	82	77	95	78	69	94	49	68	87	64	67	81
14	88	73	99	54	69	96	62	72	85	51	68	92
15	58	73	99	58	69	88	44	72	81	54	72	85
16	41	77	97	58	68	93	41	75	91	34	75	90
17	22	79	90	42	66	86	31	78	101	35	71	105
(Freedman et al., 1999) ¹												

¹ Percentiles are based on the 1992–1994 examination of school-age children in the Bogalusa Heart Study and were estimated separately within each race, sex, and age group. Estimates were not smoothed.

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