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Nutritional and Health Outcomes of Household Food Insecurity (HFIS)

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1. Summary

Poverty, food security and malnutrition are major concerns among international health, development and economic organizations. Attention has been focused on means of eliminating food insecurity and hunger world-wide. Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Household food security is the application of this concept to the family level, with individuals within households as the focus of concern. (FAO, 2009).

The complex nature of food security indicates that in order to achieve a food secure status in a population, a range of aspects need to be assessed. Some examples on these encircle equitable sharing among household members; sufficient household production dedicated towards subsistence; use of soil, water and biodiversity conservation techniques; and the sanitary aspects of cooking. (Bhattacharya et al., 2004). Because of conceptuality, the food insecurity is a multidimensional array of behaviors and perceptions and its potential determinants and consequences are wide-ranging and multidimensional. As a result, the emerging direct qualitative measures of food security offer large potential for use at the international, national and sub-national levels. Furthermore, the increased attention has led to the realization that newer methods for monitoring the prevalence and severity of hunger and food insecurity are needed and that such methods need to be developed in a manner that reflects the perception of food security and hunger by those affected, e.g. the poor (Kennedy, 2002b). Definitions, Measurements, Socio-Demographic and Economic Aspects of Household Food Insecurity (HFIS) had been extensively explained in previous work (Hamad & Ashraf, 2016). In this review, the work focused on the Nutritional and Health Outcomes of Household Food Insecurity (HFIS)

2. Nutritional and Health Outcomes of HFIS

While much remains to be understood about the nature and severity of food insecurity and the short- and long-term consequences of this phenomenon, the concept of food insecurity has now been clearly elucidated. It can be understood most simply as deprivation in the basic need for food. Importantly, the experience of food insecurity is not static but dynamic in nature, defined by a temporal sequence of events and experiences. Graded levels of severity have been defined that appear generalizable across groups. Less severe food insecurity is characterized by qualitative compromises in food selection and consumption and possibly anxiety related to food sufficiency. As resources become increasingly depleted, food insecurity is characterized by quantitative compromises in food intake and the attendant physical sensation of hunger. At its most severe stage, food insecurity is experienced as absolute food deprivation (i.e., not eating at all). Across this continuum of severity, food insecurity also has defined psychological and social manifestations (Tarasuk, 2001).

Household food insecurity occurs commonly among poor households, contributing to poor health, nutrition and functional outcomes among children, women and the elderly. These groups were found to have inadequate calorie and nutrient intakes, lower intake of fruits and vegetables, disordered eating behaviors, lower academic achievement and were more likely to have higher cholesterol and fat intakes and be overweight and obese (Kendall et al., 1995; Kendall et al., 1996; Rose & Oliveira, 1997; Vailas et al., 1998).

Alaimo (2005) reviewed the literature about the outcomes and consequences of food insecurity. Some of his findings are:

1. Food shortage at the household level can cause reduction of food intake among individuals within that household, and/or diminished nutritional quality of individual's diets, such as nutrient deficiencies of iron or vitamin
2. Food restriction is more common among adults in food-insecure households than among children, although at least some households responded affirmatively to child, rather than adult, hunger items.
3. Research from developing countries on children's development demonstrates that food deprivation and under-nutrition result in cognitive and emotional deficits.
4. Lack of food resources not severe enough to cause hunger (repeated food restriction) or malnutrition may also contribute to these negative health, psychosocial, academic, and functional consequences that have been associated with food insecurity and food insufficiency for children and adults.
5. Importantly, it has also become clear that hunger and poor nutritional quality are not the only notable and significant outcomes that can result from food insecurity. Two additional individual outcomes are associated with food insecurity; (1) disrupted or modified household dynamics and distorted eating patterns and (2) psychological suffering and sense of deprivation.
6. Psychological suffering and hunger are two additional outcomes of food insecurity that may be of equal importance as the actual sensation of hunger and/or nutritional quality in terms of consequences of food insecurity, particularly with regard to overweight and depression. Disordered eating and psychological stress may be central to understanding the association between overweight and food insecurity found among low-income women.

2.1 Health Consequences of HFIS at the Household Level

Food insecurity may be experienced at the household and individual levels. Household-level food insecurity exists when household food stores are depleted, when the food available in the household is unsafe or of low quality, when there is anxiety about how long the food supplies will last, or when the household food is acquired in a socially unacceptable way, such as through charity, begging, or stealing. Individual-level food insecurity exists when there is uncertain or limited ability to acquire, through conventional food sources (e.g., grocery store, restaurant, gardening), food which has adequate nutrients or which provides sufficient energy, or when an individual feels deprived or has restricted food choices. Food insecurity exists when one or more concerns are present (Radimer et al., 1990; Radimer et al., 1992; Kendall et al., 1995).

There are three areas of consequences of food insecurity, at the household level. The three areas include physical, psychosocial, and socio-familial consequences. Physical manifestations reported by respondents included hunger pangs among adults or children, fatigue and or illness. Psychological manifestations related to the lack of access to food was reported by respondents to have created stress in the household illustrated by a decreased interest in food and nourishment, to fear expressed by several respondents of losing custody of their child. Socio-familial consequences reported by respondents included modified eating patterns due to consuming meals that were incomplete or unbalanced from the respondent's perspective. Respondents also indicated that the meal ritual had changed because the family gathering for meals was no longer a happy occasion. Additional socio-familial consequences reported by respondents included disrupted parent child relations with irritability, anger and less time spent with children because of increased time needed to buy food. Some of the broader social implications reported by respondents included (i) loss of productivity and reduced learning in children and adults due to the

physical impairment of lack of food, (ii) increased need for health care due to not buying medication to save money for food, and (iii) to general depression (Dill, 2002).
The diagram (Figure 1) below presents a conceptual framework which suggests that food insecurity can affect well-being through four pathways: dietary intake, hunger, changed family and social interactions, and distress and alienation. Thus, hunger is only one of the possible immediate outcomes of food insecurity, and only one of the possible mechanisms through which food insecurity is harmful (Habicht et al., 2004).

2.2 Nutritional and Health Outcomes among Women

Results from different studies showed that the mean nutrient intake was lower for women who reported themselves as having not enough food to eat. For instance, Cristofar & Basiotis (1992) found this to be true for all statistically significant food groups in their study except for total cereals and pastes, since those are low cost items, which were affordable for the households from lower food sufficiency status.
According to Tarasuk & Beaton (1999), lower energy and nutrient intakes observed among women in households with more severe food insecurity may put them at risk of nutrient deficiencies and potential nutritional problems. These inadequacies might impose detrimental long-term impact if the condition was not corrected. Besides, the study findings confirmed that women's dietary intakes are compromised in the context of reported household food insecurity.

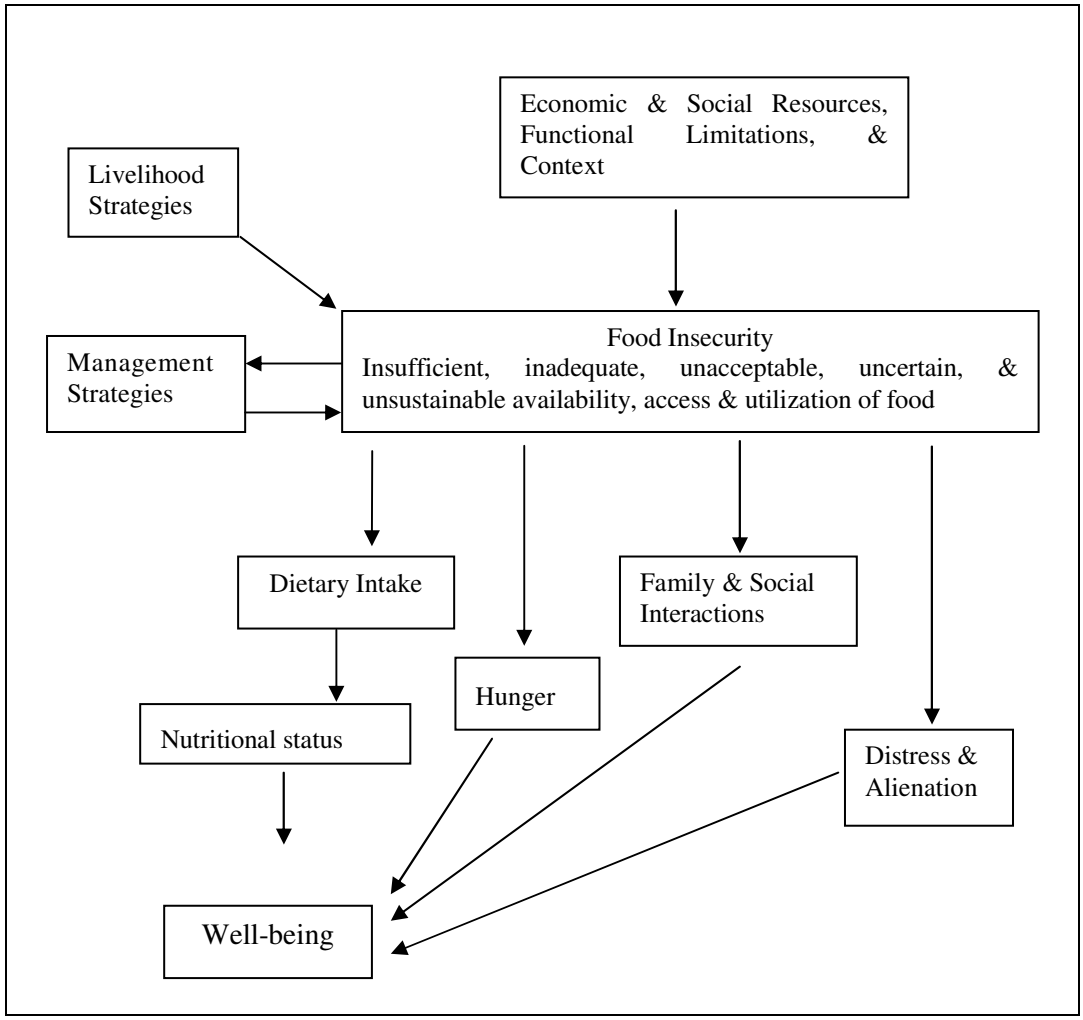

Figure 1: Determinants and consequences of food insecurity
(Source: Frongillo & Horan, 2004; Habicht *et al.*, 2004).

Many studies on the relationship between food security and obesity have been conducted. Both the food-secure and insecure groups are more likely to be obese. However although mild or moderate food insecurity is

associated with a higher risk of obesity, severe food insecurity is associated with a lower risk. However, poverty and food insecurity were not associated with obesity in men (Burns, 2004).

2.2.1 Anthropometric Measurement (Obesity)

The emergence of obesity as a worldwide phenomenon, now affecting both the poor and the rich countries alike, and both the low and high socioeconomic groups within many countries, is creating a new paradigm for public health interventions. As a result of the nutrition transition and changes in lifestyle, many low-, and middle-income countries are now faced with the coexistence of diseases of poverty, food insecurity and under-nutrition along with diseases of affluence such as obesity and chronic diseases (Ruel et al., 1999).

Alaimo et al. (2001) summarized three proposed mechanisms by which food insecurity could cause obesity. These are, first, food-insecure individuals may develop overweight because they can only afford to consume cheaper foods, which tend to be energy (calorie) dense and could result in the person consuming excessive energy and gaining weight. Second, periods without enough food could cause individuals to overeat when there is enough food, resulting in increased energy intake overall which would then cause a gain in weight. Third, fluctuations in eating habits could result in the body becoming a more efficient user of energy, meaning that the individual could increase in weight without ingesting more calories; these fluctuations may not cause lasting changes in resting energy expenditure.

Obesity can be defined simply as a disease in which excess body fat has accumulated to an extent that health may be adversely affected (WHO, 1997). Body Mass Index (BMI), an index of weight for height, is the standard measure for classifying overweight and obesity in adults. The WHO classification is based primarily on the association between BMI and mortality. A BMI of 30 or more is now widely accepted as denoting the classification of obesity (Burns, 2004).

The prevalence of dual burden households presents a significant public health concern, particularly for those countries in the middle range of gross national product (GNP). In some countries (China, Indonesia, the Kyrgyz Republic, the United States and Vietnam), dual burden households share socio-demographic profiles with overweight households and as a consequence raise concerns for underweight individuals who may inadvertently become the focus of obesity prevention initiatives (Doak et al., 2005).

A study conducted in Malaysia by Khor & Zalilah in 2003 in order to assess the presence of the dual burden of underweight child-overweight mother pairs in a poor rural community concluded that out of 140 Malay households identified to have at least one child aged 1-6 years and mother aged above 20 years, 52.1% of the mothers were overweight, 15.7% of the children were underweight, 27.1% were stunted and 5% were wasted. This study confirmed that an inadequate intake of total energy and nutrients is the major factor for underweight in Malay children from rural areas.

In a cross sectional study that investigated the nutritional outcomes related to body fat accumulation among women from low-income villages and plantations in Malaysia, 58% of the women reported some degree of food insecurity (household insecure 14%, adult insecure 9.5% and child hunger 34.5%). Overweight and abdominal adiposity among the women were associated with food insecurity, women with high numbers of children, large household sizes, limited time spent in economic activities, long time spent in leisure activities and low food variety score (Zalilah & Khor, 2005).

Almost half of the Malay households (47.4%) in the rural community of Sabak Bernam live in poverty according to the Malaysian government criteria (Khor & Zalilah, 2003). In this poor community, 52.1% of the women with at least one child aged 1-6 years were found to be overweight with BMI $\geq$ 25.0 kg/ m2. Meanwhile, 15.7% of these children aged 1-6 years had a weight for age z-score (WAZ) $\leq$ 2 SD and 37.9% had WAZ between – 2 SD and $\leq$ 1 SD. Other results of this study include that the overweight women showed a negative energy balance that could be due to overestimation of energy expenditure in physical activity and/ or under estimation of energy intake. The women could have under-reported their food intake, partly due to poor recollection of the types and quantities of the foods eaten and partly due to under-estimation of the amounts consumed (Khor & Zalilah, 2003).

This poor community showed the coexistence of the dual burden of malnutrition, namely, underweight children and overweight adults. Dual malnutrition has been defined as the possibility that underweight and overweight coexist within households overweight/ obese adults and underweight/ stunting children) in the same households (Doak et al., 2005). In addition to that, households where both mother and child are overweight present another type of dual burden; one which is poised to become much more common as the nutrition transition progresses and under-nutrition diminishes.

In a study of 193 women aged 20 to 39 years with American children living at home, Kendall et al (1995) using the Radimer/Cornell hunger and food insecurity items, found 26% households to be food-insecure, 17% had adults who were experiencing food insecurity and 10% had hungry children. The BMI was significantly higher for women in the household food insecure group compared with food secure group (28.2 vs. 25.6 kg/m2). In

addition, 37% of the women in the household food-insecure group had a BMI > 30 (obese) compared with 26% of women in the food-secure households.

A year later, Kendall et al (1996), in a multiple linear regression model controlling for all known influences on body weight including income household showed that food security was positively related to BMI. In this study the women in the food-insecure households were on average 2 BMI units heavier than those in households that were food-secure. The Kendall et al study (1996) pinpoints that those who were food-insecure but not at an extreme level appear to have higher BMIs and thus are at greater risk of poor health outcomes.

In an analysis of the 1994-1996 Continuing Survey of Food Intakes by Individuals (CSFII), Townsend et al. (2001) used a four-item food security scale and found that overweight (BMI > 27.3 kg/m2 for women and 27.8 kg/m2 for men) was related to overweight status for women (n = 4509), but not for men (n = 4970). Excluding the 11 severely insecure women, the prevalence of overweight among women increased as food insecurity increased from 34% for those who were food-secure to 41% for those who were mildly food-insecure and to 52% for those who were moderately food-insecure. In a logistic regression analysis, mildly food-insecure women were 30% more likely to be overweight than those who were food secure. On the other hand, severe food insecurity in adjusted analysis was not predictive of overweight.

Adams et al. (2003) analyzed the relationship between food security and obesity in data derived from a telephone survey of 8169 women in the California Women's Health Survey. Obesity was more prevalent in food-insecure (31.0%) than in food-secure women (16.2%). Food insecurity without hunger was associated with 36% increased risk of obesity in whites and a 47% increased risk in others. Food insecurity with hunger was associated with increased risk of obesity for Asians, Blacks and Hispanics (OR= 2.81; CI (1.84–4.28)) but not for non-Hispanic Whites (OR = 0.82; CI (0.57–1.55)). It turned out that food insecurity was associated with increased likelihood of obesity irrespective of income and education.

In a Finnish study of 25 to 64 year old men and women, Sarlio-Lahteenkorva & Lahelman (2001) investigated the association between economic disadvantage, food insecurity and self-reported body weight. They classified the respondents by their body mass index (BMI) (calculated from self-reported weight and height) into four groups: thin, normal, overweight and obese. Their findings suggested that deviant body weight (thin or obese) was associated with food insecurity. Thin people were the most likely to be hungry and food insecure. This hunger and food insecurity were assessed by five separate items concerning economic fears and experiences related to sufficient supply of food during the past 12 month, and a combined scale with affirmative responses to these items. Only thinness was associated with hunger. Those who experienced extreme hunger were twice as likely to be thin as those who did not.

On the other hand, the Australian national data indicates that obesity is most prevalent amongst those at highest risk of food insecurity. The co-existence of obesity and food insecurity sounds contradictory. Whereas links between food insecurity and low diet quality might be expected, the association between food insecurity and overweight is something of a paradox. (Burns, 2004).

The exact causes of the emergence of under and over-nutrition in the same household remain to be determined. Most research on the topic suggests that members of the household are probably not experiencing the changes in physical activity and diet that accompany the nutrition transition uniformly, leading to different individual outcomes (Popkin & Doak 1998; Doak et al., 2005). Indeed, differences in how infants and small children and adults experience the nutrition transition seem quite likely.

The following hypotheses, along with the aforementioned, could explain the link between food insecurity and obesity (Garrett et al., 2003):

1) Economic hypothesis: "it is very cheap to become obese". At world market prices, fats and sugar are cheap, energy-dense foods. This encourages high consumption and high energy intakes which are reinforced by the positive hedonic properties "tastiness" of these energy-dense foods.

2) The anthropological hypothesis, also known as "bad behaviors", i.e. poor diet, poor exercise and weight control, are the product of cultural differences between poor or food-insecure people and the middle or upper classes who are attempting to educate or improve them. This implies that poor diet or physical activity habits are not so much "bad" behaviors but different behaviors normative to particular classes or sub-classes of people.

Although the nutritional status has been one of the most popular indicators used for HFS, there are a number of fundamental conceptual problems associated with its use. First, because nutritional status is a result of several factors in addition to food consumption, it does not always correlate directly with food availability and access. For example, there was no correlation between HFIS and nutritional status in a study carried out in Mali (Staatz et al., 1990). Factors such as health status (e.g. disease prevalence), sanitation, mother care, and the level of activity of the individual can influence nutritional status outcomes. Secure access to enough food to meet household food needs is a necessary but not sufficient condition for good nutritional status (Maxwell & Frankenbreger., 1992)

2.2.2 Dietary Intake

Malnutrition is not just caused by not getting enough food. Poor diet quality is increasingly the main food consumption threat to poor people around the world. Diets can be poor in terms of what they do not contain, minerals and vitamins, for example, or sufficient quantities of whole grains, fiber, fruits, and vegetables. They also may be substandard because they contain too much of things that are harmful in excess, such as saturated fat, sodium, and added sugar …etc. (IFPRI, 2003).

Cristofar & Basiotis (1992) Results reported that the mean nutrient intake was lower for women who reported themselves as not having enough food to eat. This was true for all statistically significant food groups in the study except for total cereals and pastes, since those are low-cost items, which were affordable for the households from lower food sufficiency status.

Increasingly, poor dietary quality is overtaking hunger as the chief nutritional problem facing poor people worldwide. Poor diet quality includes both no enough vitamins and minerals or other essential nutrients and too much of other food components such as saturated fats, added sugars and salt. The latter can lead to obesity and increase the risk of "non-communicable" diseases such as diabetes and cardiovascular diseases. Diet changes and reduced exercise-with resulting negative health consequences—are spreading at historically rapid rates and they disproportionately affect the poor (Overmeyer, 2004). For this reason other researchers suggested that, obesity prevention efforts should focus on messages that are beneficial to the good health of all, such as increasing fruit and vegetable intake, improving overall diet quality and increasing physical activity (Doak et al., 2005).

In his review, Burns (2004) attracts attention to that; most of the studies on the relationship between food security and obesity followed the cross-sectional experimental design. As a consequence, any inferences regarding cause and effect must be made with caution and should be considered preliminary. A causal relationship between food insecurity and obesity has not been established.

The inverse relation between energy density and energy costs would indicate that "obesity-promoting' foods simply offer the most dietary energy at the lowest cost. They are more satiating for less expenditure. Given the differential in energy costs between energy-dense and energy-dilute foods, the advice to replace fat and sweets with fresh fruits and vegetables may have adverse economic consequences for low income consumers (Burns, 2004).

2.2.3 Physical activity levels

Globalization, urbanization, and economic growth are rapidly changing consumption patterns and lifestyles in the developing world. People are becoming more sedentary and are consuming diets that contain more calories than they need and too few essential micronutrients. Not surprisingly, such populations experience higher rates of obesity and diet-related chronic diseases, the so-called "diseases of affluence", previously restricted to the industrialized world. These kinds of problems are becoming common in countries still coping with a heavy burden of disease caused by nutritional deficiency or poverty. In Mexico, Egypt, India, Brazil, and Nigeria, for example, obesity and non-communicable diseases are reaching epidemic levels, even though these countries are still struggling to eliminate the childhood under-nutrition outreach (IFPRI, 2003).

The goal for physical activity focuses on maintaining healthy body weight. The recommendation is for a total of one hour per day on most days of the week of moderate-intensity activity, such as walking. This level of physical activity is needed to maintain a healthy body weight, particularly for people with sedentary occupations. Because prevention of obesity is a central health goal, the recommendation of 60 minutes a day of moderate-intensity activity is considered appropriate. Activity of moderate intensity is found to be sufficient to have a preventive effect on most, if not all, cardiovascular and other metabolic diseases. (WHO, 2003)

In recommending physical activity, potential individual risks as well as benefits need to be assessed. In many regions of the world, especially but not exclusively in rural areas of developing countries, an appreciable proportion of the population is still engaged in physically demanding activities relating to agricultural practices and domestic tasks performed without mechanization or with rudimentary tools. Even children may be required to undertake physically demanding tasks at very young ages, such as collecting water and firewood and caring for livestock. Similarly, the inhabitants of poor urban areas may still be required to walk long distances to their jobs, which are usually of a manual nature and often require a high expenditure of energy. Clearly, the recommendation for extra physical activity is not relevant for these sectors of the population. (WHO, 2003).

2.2.4 Biochemical Nutritional Markers

Using nutritional biomarkers is extremely important in nutritional epidemiology research and it is important for the researcher, when choosing a biomarker, to understand how a nutritional biomarker relates to both dietary intake and the chronology of exposure. This includes discussion of whether the biomarker will be used to evaluate long-term nutritional status, recent dietary intake, effectiveness of dietary manipulation or the efficacy of an intervention (Blanck et al., 2003). Serum lipids and lipoproteins are included as an example of the nutritional biomarkers. Lipoproteins are multi-component complexes of proteins and lipids and each type has a

characteristic molecular mass, size, chemical composition, density and physiological role (Devlin, 1997). Further explanation of biochemical indicators was mentioned in the literature under the metabolic syndrome section.

2.2.5 HFIS and Metabolic Syndrome (MS)

Food insecurity is used to denote the limited, inadequate, or insecure access of individuals and households to sufficient, safe, nutritious, personally acceptable food both in quality and quantity to meet their dietary requirements for a healthy and productive life (Tarasuk, 2005). As resources become increasingly depleted, food insecurity is characterized by quantitative compromises in food intake and the attendant physical sensation of hunger. At its most severe stage, food insecurity is experienced as absolute food deprivation (i.e., not eating at all). Across this continuum of severity, food insecurity also has defined psychological and social manifestations (Tarasuk, 2001).

Household food insecurity occurs commonly among poor households, contributing to poor health, nutrition and functional outcomes among children, women and the elderly. These groups were found to have inadequate calorie and nutrient intakes, lower intake of fruits and vegetables, disordered eating behaviors, lower academic achievement and were more likely to have higher cholesterol and fat intakes and be overweight and obese (Kendall et al., 1995; Kendall et al., 1996; Rose & Oliveira, 1997; Vailas et al., 1998).

Poor households spent their expenditure on additional food without modifying the composition of their food balance, acquiring most of their calories from carbohydrates and only a marginal amount from proteins (meat, fish, eggs, and legumes) and oils and fats (Thang and Popkin, 2004). On the other hand, rich households, tended to buy more expensive items like fish, beverages, oil, vegetables, and processed food as replacements for rice. In addition, Thang & Popkin (2004) found that rich households do not significantly increase the proportion of calories from proteins (only fish increases), while they increase that from lipids and from processed food, typically rich in saturated fats and refined sugar. This shift towards products that are generally associated with increased risk of obesity, diabetes and heart diseases, and certain types of cancer is of great concern if we take into consideration that it occurred only at the beginning of the economic boom faced by the country. In particular urban areas in the south East Asian countries the overweight population is steadily increasing (Cuong et al. 2006).

According to Tarasuk & Beaton (1999), lower energy and nutrient intakes observed among women in households with more severe food insecurity may put them at risk of nutrient deficiencies and potential nutritional problems. These inadequacies might impose detrimental long-term impact if the condition was not corrected.

Many studies on the relationship between food security and obesity have been conducted. Both the food-secure and insecure groups are more likely to be obese. However although mild or moderate food insecurity is associated with a higher risk of obesity, severe food insecurity is associated with a lower risk. However, poverty and food insecurity were not associated with obesity in men (Burns, 2004). In a large European study of postmenopausal women followed up for a mean of 8.5 years, cardiovascular mortality was strongly related to abdominal obesity and to all elements of the metabolic syndrome, especially elevated serum triglycerides (Tanko et al., 2005).

2.3 Nutritional and Health Outcomes among Children

Several studies done on the effects of hunger and food insecurity on children concluded that they are significant risk factors for poorer health, lower academic achievement, diminished psychological well-being and higher levels of behavioral problems. Food insecure children are more susceptible to nutrient inadequacy due to insufficient food intake. The most serious effects of under-nutrition on children are growth retardation, increased vulnerability to illnesses, and limited capabilities for movement and for cognitive development (problems with immunological maturation) (Kates, 1996; Brown, 2002; Kaiser et al., 2002; Khor, 2002).

Almost one third of all children in developing countries are stunted, with heights that fall far enough below the normal range for their age to signal chronic under-nutrition. Stunting, like low body weight, has been linked to increased illness and death, reduced cognitive ability and intermittent school attendance in childhood and to lower productivity and lifetime earnings in adults. When stunting occurs during the first five years of life, the damage to the physical and cognitive development is usually irreversible, Figure 2 (FAO, 2004).

It seems that the developing countries going under nutrition transition are characterized by a wide range of prevalences of malnutrition. Moy et al., (2004) report the observed body mass status of total 3620 Malaysian school children. There were a total of 7.3% of overweight students and 14.8% of underweight students. They found that the prevalence of underweight was highest among the Indian students (24.9%), followed by Malays (18.9%) and Chinese (9.5%).

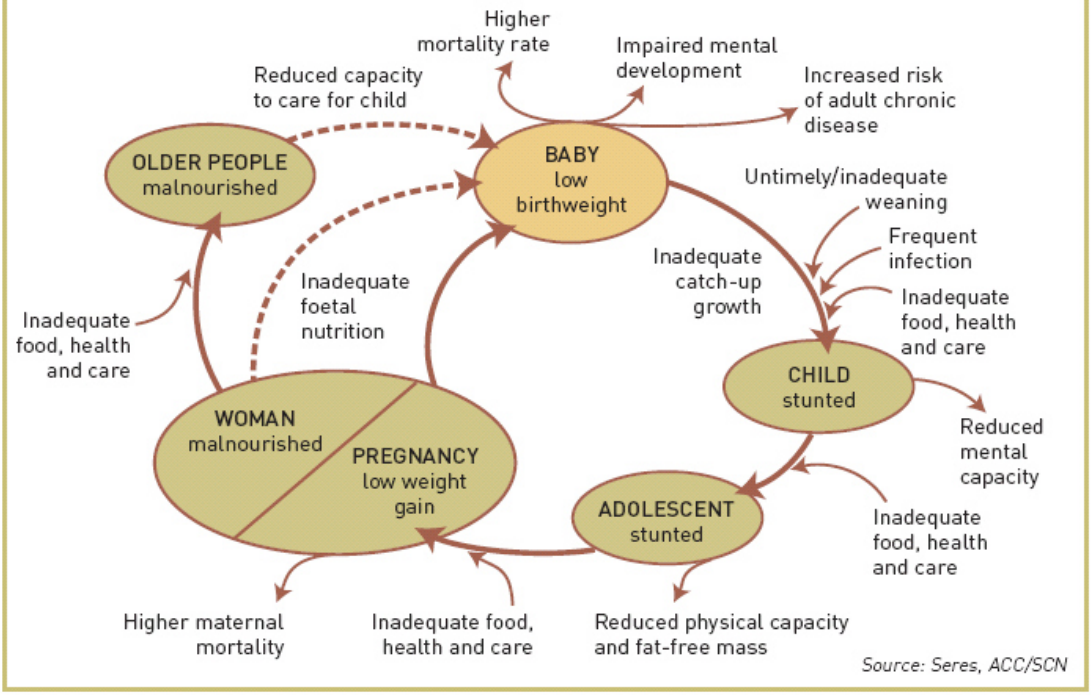

Figure 2: Impacts of Hunger and Malnutrition throughout Human Life Cycle (Source: FAO, 2004)

Khor & Zalilah (2003) reported that the underweight children in their study consumed significantly less macronutrients, including energy, fat and protein than their normal weight counterparts. However, energy expenditure in physical activity did not differ significantly between the two groups. Thus, the underweight children are too thin for their age because they are not eating enough energy-dense food for putting on weight.

A study was conducted by Zalilah et al in 2000 among urban areas (Kuala Lumpur), to investigate the relationship between nutritional status and educational achievement among primary schoolchildren (6-10 years old) coming from low income households (n = 399). They found a high percentage of them were mild-significantly underweight (52%), stunted (47%) and wasted (36%) and increasingly overweight (6%). As a conclusion, results demonstrate a high prevalence of underweight, stunting, wasting and an increasing prevalence of overweight among low-income school children.

Khor & Tee, 1997 found that the prevalence of underweight among boys and girls was 29.1% and 26.1% respectively; an average of 34.4% boys and 24.9% girls were stunted; however, the prevalence of wasting among these children was much lower (boys = 8.2%; girls = 6.2%). In another study conducted among primary school children (Year 1 and 6) from rural and urban schools, the overall prevalence of overweight and obesity was 7.8% (Bong and Jaafar., 1996).

Other international data from developed countries indicate that the prevalence of obesity among children increased during the last couple of years. El-Mouzan et al in 2010 summarized some of them. For example, in US, the prevalence of obesity in 1999–2000 was 15.5% among 12- to 19-years old, 15.3% among 6- to 11-years old, and 10.4% among 2- to 5-year-olds. In UK, the prevalence of obesity in 11–15 years old was 25% in 2004. However, in India, consistent low prevalence of overweight (6.67% in 2005) has been reported (El-Mouzan et al., 2010).

Low diet quality in children usually results in inadequate micronutrient intake, which in turn causes micronutrient deficiencies and poor growth, health, and developmental outcomes. On the other hand, low quality diets in adults may also result in micronutrient deficiencies and increase the risks of obesity because of the excessive amounts of energy, saturated fats, and refined sugars that these diets often contain. Poor dietary quality among energy sufficient households may thus be a determinant of stunted children and overweight mothers (SCOWT). Along these lines, overweight and obesity may exist among the stunted children included in SCOWT pairs as a result of affluence and positive energy balance. Recent research highlights the existence of an

association between obesity and stunting in children in countries undergoing a nutrition transition (Garrett et al., 2003).

A study was conducted by Alaimo et al. (2001) to investigate associations between family income, food insufficiency, and being overweight in US children aged 2 to 7 and 8 to 16 years, and to identify the mechanisms that may explain these associations. In this study a child was classified as “food-insufficient" if the respondent to the family questionnaire reported that the family either "sometimes" or "often" did not get enough food to eat. Among older non-Hispanic white children, children in families with low income were significantly more likely to be overweight than those in families with high income.

Recent researches emphasized that the WHO Child Growth Standards (2006) appear to be more suitable reference for the surveillance of overweight in preschool children (El-Mouzan et al., 2010; Dietitians of Canadian and Canadian Pediatric Society, 2010), school children and adolescents (Dietitians of Canadian and Canadian Pediatric Society, 2010).

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