NUTRITIONAL STATUS OF RURAL PRIMARY SCHOOL CHILDREN AGED 7 TO 12 YEARS OLD IN DISTRICT OF PITAS, SABAH MEASURED USING ANTHROPOMETRY, DIETARY HABITS AND HOUSEHOLD INCOME.

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SCHOOL OF FOOD SCIENCE AND NUTRITION
UNIVERSITI MALAYSIA SABAH

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ABSTRACT

Nutritional status evaluation of primary school children aged 7 – 12 years old was carried out in Pitas, Sabah. Three primary school were selected for the study involving 360 (180 boys, 180 girls) pupils in Standard 1 until Standard 6. Focus in this study was measurement of weight and height and Body Mass Index (BMI) calculation, measurements were compared with NCHS/ CDC 2000 growth chart. Parent-assisted questionnaires were used to study demographic, medical history, dietary habits and food frequency consumption. This study defined significant, mild underweight and stunting, overweight and obesity based on percentiles of the NCHS/ CDC references. Using weight-for-age charts, approximately 91% (n=327) were categorized as significantly or mildly underweight. Using height-for-age charts, about 93% (n=334) were significantly or mildly stunted. This study found that 3.3% (n=12) and 1.7% (n=6) in this sample were overweight and obese, respectively, based on 85th and 95th percentiles of BMI-for-age curves. Pearson's correlation test found significant correlation between frequency of consumption for fruits group which is food group 2 ($r=0.106$, $p<0.05$) and vegetables group which is food group 3 ($r=0.116$, $p<0.05$), respectively with family wages and food group 5 (milk and dairy products) with family wages ($r=0.156$, $p<0.01$). For growth status, only BMI-for-age was correlated with family wages ($r= - 0.54$, $p<0.05$). In conclusion, the results demonstrate high prevalence of stunting and underweight, and low prevalence of overweight and obesity among these primary school children.

ABSTRAK

Penilaian status pemakanan kanak-kanak sekolah rendah berumur 7 – 12tahun di daerah Pitas, Sabah, diukur menggunakan kaedah antropometri, tabiat pemakanan dan pendapatan keluarga.

Penilaian status pemakanan di kalangan pelajar sekolah rendah berumur 7 – 12 tahun telah dijalankan di daerah Pitas, Sabah. Tiga sekolah rendah telah dipilih untuk kajian ini dan melibatkan 360 (180 lelaki, 180 perempuan) pelajar Darjah 1 hingga Darjah 6. Tumpuan kajian adalah ke atas pengukuran berat, tinggi dan pengiraan Indeks Jisim Tubuh (IJT), dan perbandingan pengukuran dengan carta pertumbuhan NCHS/ CDC 2000. Borang kaji selidik yang dilengkapkan dengan bantuan ibu bapa pelajar telah digunakan untuk mengkaji data demografik, sejarah perubatan, tabiat pemakanan dan frekuensi pengambilan makanan. Kajian ini mendefinisikan kekurangan berat badan dan kebantutan, berat badan berlebihan dan obesiti berdasarkan persentil jisim untuk umur, tinggi untuk umur dan BMI untuk umur pada carta pertumbuhan NCHS/ CDC 2000. Dengan menggunakan carta berat-untuk-umur, sekurang-kurangnya 91% (n=327) dikategorikan sebagai kekurangan berat badan yang signifikan atau sederhana. Dengan menggunakan carta tinggi-untuk-umur, 93% (n=334) adalah terbantut secara signifikan atau sederhana. Kajian ini juga mendapati 3.3% (n=12) dan 1.7% (n=6) kanak-kanak mengalami berat badan berlebihan dan obesiti, masing-masing berdasarkan persentil 85^{th} dan 95^{th} pada lengkung pertumbuhan. Ujian korelasi Pearson menunjukkan perkaitan di antara kekerapan pengambilan sehari kumpulan buah-buahan iaitu kumpulan makanan 2 ($r=0.106$, $p<0.05$) dan kumpulan sayuran iaitu kumpulan makanan 3 ($r=0.116$, $p<0.05$) dengan pendapatan keluarga dan kumpulan makanan 5 (susu dan produknya) dengan pendapatan keluarga ($r=0.156$, $p<0.01$). Manakala, untuk status pertumbuhan, terdapat perkaitan di antara BMI untuk umur dengan pendapatan keluarga ($r= - 0.112$, $p<0.05$). Kesimpulannya, terdapat kelaziman yang tinggi untuk kekurangan berat badan dan kebantutan, dan kelaziman yang rendah dalam berat badan berlebihan dan obesiti di kalangan kanak-kanak sekolah rendah ini.

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SYMBOLS AND SHORT FORMS

%	percentage
1/2	Half in measurement
BMI	Body mass index
cm	centimeters
CDC	Chronic Disease Center
DNA	Deoxyribonucleic acid
g	gram
kg	kilogram
NCHS	National Center fro Health Statistics
n	Total number
RM	Currency for Ringgit Malaysia
SK.	Sekolah Kebangsaan
WHO	World Health Organisation
<	Less than
>	More than

CHAPTER 1

INTRODUCTION

1.1 Introduction

A nutritional status evaluation is an in-depth evaluation of both objective and subjective data related to an individual's food and nutrient intake, lifestyle, and medical history (Drummard, 1996). There are many elements in evaluating nutritional status for an individual. Those elements are anthropometric, biochemical, clinical and dietary. The data that are collected by using these elements can be used to evaluate nutritional status of an individual. Nutritional status evaluation is very important for assessment of health and nutritional risk, especially in children (Corish & Kennedy, 2003). Nutritional conditions that commonly related to children are overweight, underweight, stunting and wasting. These nutritional conditions most probably occur because of malnutrition.

Malnutrition, both undernutrition and overnutrition may prevail in the same community at the same time (Norimah & Lau, 2000). Earlier studies have reported that under nutrition was more prevalent in the rural communities (Chong *et al.*, 1984; Zawiah *et al.*, 1985). In a community, the group which is more affected by undernutrition is children (Norimah & Lau, 2000). Recent reports have indicated that malnutrition manifested as underweight and stunting are still prevalent, and are becoming worse among children from poor rural communities and indigenous population

groups (Khor, 2000; Wan Abdul Manan *et al.*, 1999). Children's eating habits that are developed during childhood affect their health and nutritional status during adulthood. Children from low socioeconomic areas might not be able to exercise good nutrition practices due to limited household income and consequently food availability (Norlijah *et al.*, 2005). Communities in rural areas are usually related to low monthly income and it is very hard to provide their children with stable and nutritious diet. Therefore, children from rural communities will most likely be undernourished or face nutritional deficiencies. By doing nutritional status evaluation from the early age, children may have the chance to change their eating habit and consequently their nutritional status before reaching adulthood.

Anthropometric measurements (body dimensions and composition) are often used as proxies for assessing the eventual extent and severity of malnutrition (Chevassus-Agnès, 1999). Anthropometry-based nutritional assessment has the advantage of being a universally applicable, inexpensive and non-invasive method (WHO, 1983). This procedure also is applicable to large sample sizes. It can be used to identify target groups of population or areas for intervention, as a tool for nutritional surveillance, and in cross-sectional evaluation. The classic indicators of anthropometric measurements have to do with growth development for children and body composition for adults (Chevassus-Agnès, 1999).

The measurements that are essentials for anthropometric are weight, height, age and sex. For children's anthropometric measurement, the indicators that are usually used are weight for age percentiles, height for age percentiles and body mass index for age percentiles. Weight for age reflects body mass relative to chronological age. Low in weight for age index identifies children who are underweight based on their age. This

index reflects both past and present undernutrition. Height for age, this term is for children aged 2 years and above, and low in height for age index is referred to as stunting. This condition reflects past undernutrition or chronic malnutrition. Weight for height reflects body mass relative to height. Low in weight for height index identifies children suffering from current or acute undernutrition or wasting. High in weight for height index will be described as overweight. Body Mass Index (BMI) reflects also body mass relative to height and is mainly used for adults and adolescents. High BMI permits to assess degrees of overweight and obese people and low BMI to assess different levels of thinness.

1.2 Research objective

The purpose of this research is to fulfill these objectives:

1. To measure anthropometric parameters namely height and weight and calculate BMI of respondents.
2. To obtain food intake data specifically the food frequency intake of food groups in the food guide pyramid.
3. To determine the prevalence of certain growth status for children (underweight, stunting, overweight).
4. To investigate the relationship between demographic factors and socioeconomic factors with children's growth status.

CHAPTER 2

LITERATURE REVIEW

2.1 Nutritional Status for Children

The definition of school age children corresponds approximately to the period from kindergarten through lower secondary; it begins after the period of higher mortality risk in the preschool years and continues through most of the adolescent growth spurts and sexual maturation to young adulthood (Zalilah *et al.*, 2000).

Nutritional status can be assessed using several of methods; clinical signs of malnutrition, biochemical indicators and anthropometry (Onis, 2000). Scientists have been using growth assessment because it best defines the health and nutritional status of children while serving as useful indirect measurements of a population's overall socioeconomic status.

Studies for vast numbers of subjects usually use anthropometry in nutritional status assessment (Garnier *et al.*, 2003; Cheng & Kaur, 2001; Nwokoro *et al.*, 2006). Growth status of children can be an indicator of children's nutritional status. There are two ways on how a child's body may respond to malnutrition; retardation of height (growth) and body wasting as body weight for height is not suitable. However, growth status can be indicated by anthropometry measurement data; anthropometry indices, in order to identify the prevalence of malnutrition (Zalilah *et al.*, 2000).

Children's growth occurs in spurts and plateaus, but overall growth patterns are predictable, and if a child's overall pattern of growth changes, children's dietary intake

should be evaluated to determine the reason for the sudden change in growth patterns (Grosvenor & Smolin, 2003). A child's eating patterns and dietary intake might influence children, especially school-aged children, nutritional status (Shaw, 1998). Thus, the dietary intake of a child must supply the nutrients that are needed for children's growth and development, and also for body maintenance and body's physical activities.

Normal growth of children depends on many factors such as race, nutrition, environment and if being inflicted with diseases (Needman, 2005). Children's inadequacies in nutrient intake would eventually alter child's growth status, as children would adapt to low supply of nutrient intakes through the reduction of physical activity and slowed rates of growth. Socioeconomic status may also affect nutritional status; as children's from better-off socioeconomic circumstances tend to be on the average, taller, heavier and fatter from poorer socioeconomic circumstances (Malina & Bouchard, 1991).

2.2 Anthropometry Measurement

Growth and development assessment for children requires the use of standards that shows normal range of their growth and development. The most important criteria for children's growth are weight, height, head circumference and Body Mass Index (BMI) (Abolfazl & Saeed, 2005). Through measurements of these criteria and in comparing them to a standard, any abnormal conditions in children's growth status can be screened and indicated.

Anthropometry refers to the measurement of the size and proportion of the human body. Body weight and stature are measures of body size, and ratios of body weight to height can be used to represent body proportion (Heyward & Stolarczyck,

1996). This procedure is also applicable to large sample sizes. It can be used to identify target groups of population or areas for intervention, as a tool for nutritional surveillance, and in cross-sectional evaluation (Chevassus-Agnes, 1999).

Anthropometry has an advantage over biochemical indicators and clinical signs. Both biochemical indicators and clinical signs are useful on the study on the extremes of malnutrition, whereas body size measurements are sensitive over the full spectrum of malnutrition (Onis, 2000). Anthropometry also has the advantage of being persistent, inexpensive and easily obtained measurement. However, anthropometry has the disadvantage of lacking in specificity, as many factors can affect the changes in body proportions (Onis, 2000)

2.2.1 Anthropometry indices

The criteria measurement in anthropometry; weight, height and BMI, can provide information about children's growth. These measurements used together with a child's age, are called as an anthropometric indices and can provide information on children's nutritional status. Three indices that are commonly used in children's growth status assessment are weight-for-age, height-for-age and BMI-for-age. Most nutritional studies on primary school children in Malaysia used these anthropometric indices as childrens' nutritional status indicator (Osman *et al.*, 1993; Bong & Jaafar, 1996; Kasmini *et al.*, 1997; Khor & Tee, 1997).

Table 2.1: Common terms of height- and weight-based anthropometric indicators

Anthropometric Indicator	Terms describing outcomes	Terms describing process	Explanation
Low height-for-age	Shortness	-	Descriptive
	Stunted	Stunting (gaining insufficient height relative to age)	Implies long-term malnutrition and poor health
Low weight-for-height	Thinness	-	Descriptive
	Wasted	Wasting (gaining insufficient weight relative to height)	Implies recent or continuing current severe weight loss
High Body Mass Index	Heaviness	-	Descriptive
	Overweight	Gaining excess weight relative to height	Implies obesity
Low weight-for-age	Lightness	-	Descriptive
	Underweight	Gaining insufficient weight relative to age, or losing weight	Implies stunting and/ or wasting
High weight-for-age	Heaviness	-	Descriptive
	Overweight	Gaining excess weight relative to weight	Implies overweight as a result of obesity

Source: WHO Expert Committee, 1995

2.2.2 Height-for-age

This index reflects achieved linear growth and its deficits indicate long-term, collective inadequacies of wellbeing or diet (WHO, 1995). Standing height measurement is often referred as stature, and usually used for those who can stand well. Shortness is an

expressive definition of low height-for-age. Stunting is another commonly used term in reflecting low height-for-age, and it reflects a process of failure to reach linear growth potential as a result of nutritional conditions (WHO, 1995). High height-for age is an indicator that is less significant with public health concerns.

In less urbanized areas, the prevalence of low height-for-age may be safely assumed as stunted. However, in urban areas, where prevalence of low height-for-age is little, it may be safely assumed as genetic factors. Because height deficits result from long term process, chronic malnutrition is often used as term to described stunted. This seems to imply the deficits may be caused by poor nutrition.

2.2.3 Weight-for-age

Weight-for-age is influenced by both the height of the child and his weight, and its composite nature make understanding complex. Weight-for-age reflects long-term health and nutritional status of individual or population (WHO, 1995). Changes in weight-for-age reveals change in weight-for-height.

According to WHO (1995), low weight-for-age has been used to refer as underweight and reflects underlying pathological process. The term underweight has been widely used to express the condition in high-prevalence areas of low weight-for-age. High weight-for-age is seldom used for public health studies because other indicators, such as high BMI-for-age are more useful in expressing overweight or obesity problems.

2.2.4 BMI-for-age

Body mass index (BMI) is calculated by dividing weight in kilograms by the square of height in meters. BMI-for-age index was usually used in determining prevalence of overweight and obesity. High BMI-for-age indicates overweight and obesity while low BMI-for-age usually indicates underweight, but commonly used index for underweight is weight-for-age index (WHO, 1995). In BMI-for-age growth curve developed by NCHS/ CDC, variation of age widen until children aged 2 years old. Usage of BMI as a reference didn't only limited for adolescents and adults (WHO, 1995)

2.2.5 National standard growth reference

Various factors such as race and genetics can influence growth status of children; thus different countries need to use their specific relevant growth model (Abolfazl & Saeed, 2005). In Malaysia, most studies involving nutritional status use CDC 2000 growth reference standard (Zalilah *et al.*, 2000). In general, growth parameters including height and weight are highly inherited traits (Thomis & Towne, 2006). Therefore, it is possible that growth status of Malaysian children may be low compared to reference standard. According to Butte *et al.* (2007), the present NCHS/ CDC 2000 growth chart have certain limitation to be widely used for world population because of inherited traits (race) factor.

2.3 Factors affecting growth status of children

The ultimate size (height and weight) that an individual will attain is affected by many factors such as socioeconomic, nutritional, genetics and lifestyle factors included (Grosvenor & Smolin, 2003). These factors will affect the growth and development of

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