Effects of zinc deficiency

INTRODUCTION

Zinc is a trace mineral that plays an indispensable role for human health because of its critical structure in multiple enzymes that are involved in gene expression, cell development and replication (International Zinc Nutrition Consultative Group [IZiNCG], 2007). Aside from its unique and extensive role in biological processes, zinc is essential for physiological processes including growth and development, and brain and immune function (Ackland and Michalczyk, 2006). More than 85% of total body zinc is found in skeletal muscle and bone (National Health and Medical Research Council [NHMRC], 2006) as well as in the brain that plays a central role in the production of enzymes essential for RNA and DNA synthesis (Black, 1998).

Zinc deficiency affects, on average, one-third of the world’s population ranging from 4 to 73% in different countries (Hotz and Brown, 2004). It has been estimated that zinc deficiency is responsible for deaths of nearly 450, 000 children under age 5 years old annually (Black et al, 2008). Similarly, zinc deficiency is accounted for 16% lower respiratory tract infections, 18% of malaria and 10% of diarrheal disease and more than 28 million aggregates to loss of disability-adjusted life years (DALYs). In total, 1. 4% (0. 8 million) of deaths worldwide were attributable to zinc deficiency: 1. 4% in males and 1. 5% in females (WHO, 2012).

Zinc deficiency is defined by short stature, hypogonadism, impaired immune function, skin disorders, cognitive dysfunction and anorexia (Prasad, 1991). Zinc deficiency is uncommon but a widespread problem across the globe (Ackland and Michalczyk, 2006). It has far-reaching consequences, playing a

contributory role to stunted growth in children (Brown et al., 2001) and causing abnormal cerebellar function and damage of behavioural and emotional responses (Henkin, 1975) in addition to morbidity from diarrhea, pneumonia and malaria (Shankar, 2000). Therefore, zinc deficiency compromises the development of children worldwide and is a veritable public health concern (Gibson, 2005).

Background of the Study

Micronutrients have been scientifically and technically discovered to improve the overall well-being of an individual and that deficiencies can cause a range of health and developmental problem. Zinc is one of the micronutrients that promote immunity, resistance to infection as well as growth and development of the nervous system.

Zinc deficiency can lead to more frequent infections, reduce children’s ability to fight and survive disease, and impair mental capacity. These risks remain serious as children grow and develop because they cannot learn as well, and lose school days due to illness. Later in adulthood, it negatively affects physical energy and, therefore, productivity. Reduced intellectual capacity undermines investments in education and perpetuates cycles of poverty, which is a significant barrier to achieve economic growth and improved standards of living. In addition, intellectual ability is affected by iron which affects work capacity, physical and cognitive performance (Global Report, 2009).

Zinc has the primary focus of scientific investigations related to linear growth which is intimately connected to nutrition. As a manifestation of chronic

undernutrition, stunting has been linked to multiple adverse health outcomes that extend beyond childhood into adult life (Souganidis, 2012). Recent evidences also suggest that zinc deficiency may be associated with deficits in activity, attention, and motor development that commonly occur in nutritionally deficient children (Souganidis, 2012) because it contributes to the structure and function of the brain (Black, 1998).

According to the World Bank (2012), the Philippines ranks 48 th out of 136 countries in terms of the prevalence of stunting and 32% of Filipinos are at risk for insufficient zinc intake. Generally, zinc status is of high magnitude (> 20%) among infants and preschool children (6 months to 5 years), female adolescents (13 to 19 years), older persons (20 to <60 years) and pregnant women (FNRI, 2008). The result of the 2008 National Nutrition Survey (NNS) suggests that the level of zinc deficiency among other age groups may as well be of public health significance. In addition, Filipinos usually consume 70% of staple foods particularly of plant origin like rice and corn, which contain high levels of phytate, that are likely to prevent zinc absorption. Similarly, the NNS revealed that stunting is associated with high prevalence of anemia in 6 to 60 month old children. Meanwhile, cognitive development of 0 to 6 years old Filipino children are affected by stunting and being underweight; 30% of children with delayed cognitive abilities are stunted (Barba, et al., 2004).

Statement of the Problem

Zinc deficiency has been a major micronutrient problem in the Philippines. It has been associated with linear growth and cognitive development. Zinc has

also been related to iron due to their inhibitory factor with one another. The effect of zinc on physical growth occurs during the first 2 years of life with association to high rates of infection, inadequate nutrition and cognitive deficits. The following questions were highlighted in the study to examine the association of zinc status to nutritional status, iron status and cognitive development as well as possible risk factors of zinc deficiency in 2 to 3 year old children in Laguna, Philippines.

1. What are the socio-economic and demographic characteristics, water and sanitation practices, health services, child care and feeding practices of mothers?
2. What are the food intake and nutrient adequacy of children?
3. What is the nutritional status, zinc status and iron status of children?
4. What is the level of cognitive development of children?
5. What is the degree of association between zinc status and the following variables:
    1. water and sanitation practices, and health services;
    2. child care and feeding practices, and food intake;
    3. nutritional status;
    4. iron status; and
    5. cognitive development?

Hypothesis of the Study

The following were the research hypothesis that guided the study:

1. Water and sanitation practices are associated with nutritional status.
2. Health services are associated with nutritional status.

3. Infection is associated with nutritional status and cognitive development.
4. Food intake is associated with nutritional status and cognitive development.
5. Weight-for-age, height-for-age and weight-for-height are associated with zinc status, iron status and cognitive development.
6. Zinc status is associated with iron status and cognitive development
7. Iron status is associated with cognitive development.

Objectives of the Study

Generally, this study aimed to determine the Zinc status and its relationship to physical growth and cognitive development of 2 to 3 year old children in Laguna, Philippines. It specifically sought to:

1. describe the socio-economic and demographic characteristics; water and sanitation practices; health services; and child care and feeding practices of mothers;
2. evaluate the food intake and nutrient adequacy;
3. assess the nutritional status, zinc status and iron status;
4. determine the level of cognitive development; and
5. examine the association of zinc status with each of the following variables:
    1. water and sanitation practices;
    2. health services;
    3. child care and feeding practices, and food intake;
    4. nutritional status;
    5. iron status; and

6. cognitive development.

Significance of the Study

The province of Laguna has been consistent in the implementation of nutrition programs. The nutrition sector has been conducting nutritional assessment to address the magnitude and severity of malnutrition particularly, of under and overnutrition in the province. However, zinc deficiency, as one of the public health concerns, and its multifactorial causes have not yet been given attention. With limited researches, the assessment of zinc status provided a deep understanding of the consequences of stunting and iron status as well as its contributory effect to cognitive development of 2 to 3 year old children.

The results of the study shall provide local government units, program planners and policy makers with significant inputs for relevant programs; suggested and recommended effective nutrition strategies to local nutrition and health workers; and imparted to nutrition and nutrition-related professionals knowledge and awareness on micronutrient deficiencies, particularly of zinc.

Scope and Limitations of the Study

The study focused on the assessment of physical growth, zinc status, iron status and cognitive development of 2 to 3 year old children in the province of Laguna. Factors affecting child nutritional status included were to socio-economic and demographic characteristics, health, water and sanitation practices, child care and feeding practices and dietary intake. Contributory factor to nutritional status such as infection was also included.

The criteria in selecting the study area and the profile of the province were limited to the availability of secondary data. The sample size was based from the 2013 Operation Timbang (OPT) list which may not include all children with ages 24 to 35 months old. Data on child morbidity was limited to personal interview of mother-respondents. Likewise, dietary assessment was limited to a non-consecutive 2-day food recall which may not indicate foods that are highly seasonal. Determination of cognitive development was also limited to the adapted items of the Early Childhood Care and Development (ECCD) program, Metro Manila Developmental Screening Test (MMDST), and Child Development Index (CDI). The sample size may not be able to reflect the entire population of 2 to 3 year old Filipino children. However, the sample size was sufficient to test the statistical significance of the study. The conclusions were made from the results of the study. Hence, it was limited to the conditions inherent to the selected children.