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Zinc Status of Filipinos by Serum Zinc Level

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Zinc deficiency has been considered an important and widespread risk to human health, ranking 5th among the 10 leading causes of illness and disease in developing countries. To date, zinc status data using serum zinc at national level are still very limited; hence, global prevalence remains unknown. This paper aimed to determine the serum zinc levels and magnitude of deficiency among all Filipino age/physiologic groups in the 2008 National Nutrition Survey. Utilizing a multi-stage stratified sampling design, zinc status was assessed using serum zinc levels determined by atomic absorption spectrometry. Prevalence and magnitude of zinc deficiency was evaluated using the suggested lower cut-offs and guidelines for public health concern of the International Zinc and Nutrition Consultative Group, respectively. The national estimate of zinc deficiency in the Philippines was 30.0%, with a mean serum zinc level of 84.0 ± 0.5µg/dL. Prevalence of zinc deficiency in all Filipino age and physiologic groups was considered of high magnitude (>20%). The highest prevalence was noted among lactating women (39.7%), the extent peaking among those in their 1st 6 months of lactation (45.6%). Males predominantly presented higher deficiency rates than females, except in adults (20 – 29 and 30 – 39 y-old groups). Among males, older persons ≥ 75 y-old exhibited the highest rate (39.5%). Conclusions: Zinc deficiency in the Philippines is of significant public health concern, both at the national level and in different age/physiologic groups. Lactating women is the most at-risk group to zinc deficiency and males are generally more vulnerable than females.

Key words: IZiNCG, serum zinc, zinc deficiency, zinc status

INTRODUCTION

Zinc is an essential trace element for humans. It is involved in the synthesis and degradation of carbohydrates, proteins, and nucleic acid and is required for enzymes involved in growth and bone development (Gibson 1994). Given the diverse array of biologic functions zinc performs, zinc deficiency may be more widespread and may have far reaching risks to human health than have been previously realized. Zinc deficiency ranks 5th among the 10 leading causes of illness and disease in developing countries (WHO 2002).

Recently, serum or plasma zinc was recognized and recommended as the best available biomarker in assessing zinc status in the population. As there are still very limited data using serum zinc as indicator at national level, global prevalence of zinc deficiency remains unknown. Inadequate zinc intake in a population (≥ 25.0%) and stunting rate ≥ 20% among children have been considered indicative of an elevated risk of zinc deficiency in the population (Hotz & Brown 2004) where most estimates were based. Similarity of iron and zinc in the food supply and dietary components that modify their absorption also suggest a comparable risk for deficiency for these micronutrients.

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In the 7th National Nutrition Survey (NNS) of the Food and Nutrition Research Institute (FNRI 2010), the mean per capita intake/day of meat and fish products, which are the best sources of bioavailable zinc of the typical Filipino diet, was only 83.0g and 110g or 9.6% and 12.8% of the total daily intake, respectively. In addition, a great proportion of the Filipino diet was from plant origin (70%), of which, rice and corn are main staples and contain high levels of phytate that is known to be potent inhibitor of zinc absorption. Moreover, stunting among children remained a public health problem. Anemia, based on hemoglobin levels, was generally of moderate to high magnitude among different age/physiologic groups from 1993 to 2008 NNS.These data may suggest that Filipinos of various population groups maybe at increased risk to zinc deficiency.

This study aimed to determine the serum zinc levels and magnitude of zinc deficiency among Filipino population groups.This is an important baseline zinc status data at national level and a relevant input for program planners/ policy makers in designing/formulating effective intervention strategies to improve zinc status of Filipinos. Likewise, this is a significant contribution in the data base of World Health Organization (WHO) and International Zinc Nutrition Consultative Group (IZiNCG) in assessing the global prevalence of zinc deficiency.

MATERIALS AND METHODS

Research Design and Selection

The subjects of this study were participants of the 7th National Nutrition Survey (NNS) of the Food and Nutrition Research Institute (FNRI) conducted from May to December 2008. The survey was cross-sectional in design utilizing a multi-stage stratified sampling frame of the 2008 1st Quarter Labor Force Survey (LFS) developed by National Statistics Office (NSO) covering all 17 regions of the country, including 79 provinces and the National Capital Region (NCR). Participants of the study included all 6 mo to12 yr-old school children covered in the survey, and pregnant and lactating women in 50% of the sampled households, and adolescents, adults, and the elderly in 25% of sampled households using 1 of the 4 replicates of LFS. Participants were requested to sign an informed written consent form after a thorough briefing on the protocol of the study. Age was computed as of last birthday. Gestational age of the pregnant women was computed from the date of the last menstrual flow data. Eligible participants afflicted with any kind of illness during the time of data collection were not included.

Blood collection and analysis

Morning blood sample was collected by finger prick from infants and preschool children in Becton Dickenson (BD) plain microtainer tube (Ref no. 365963) and by venous method in BD trace-element free evacuated tube (Ref. No. 369737) from school-aged children 6-12 y up to elderly group. Blood sample collected from participants ≥20 yrs was in the fasting state. Blood samples were kept inside an ice chest with wet ice while awaiting centrifugation and separation of serum from red-cell within two (2) hours after collection. Hemolyzed samples were discarded. Serum samples were stored inside a household freezer or ice chest with wet/dry ice or inside a liquid nitrogen tank while in the field and in transit to the FNRI laboratory, where samples were kept inside -80°C freezers until analyzed.

Serum zinc was determined by atomic absorption spectrometry(AAS) (Smith et al. 1979). Accuracy of the analytical method was assessed using 2 trace element standard reference materials (SRM): the National Institute of Standards and Technology (NIST)'s SRM 1598a and Sero's Seronorm Level 1. Zinc concentration of the pooled serum sample which served as the internal quality control material was analyzed with the participants' serum samples (after every fifty samples) to monitor precision in each assay day.

Statistical Analysis

SPSS and STATA were used to generate the weighted mean, standard error of the mean (SE), and the proportion of participants indicative of deficiency and 95% confidence interval (CI), as well as coefficient of variation (CV).The prevalence and magnitude of zinc deficiency were evaluated using the suggested IZiNCG's lower cut-offs and guidelines for public health concern, respectively (Hotz & Brown 2004). The cut-offs used were: children < 10 yrs 65 µg/dL, and children ≥ 10yrs to 19 years, 70 and 66 µg/dL (males and females, respectively). For adult 20 yrs and over the cut-offs in the fasting state category were employed (74 µg/dL for males and 70 µg/dL for non-pregnant females), while 66 µg/dL was used for pregnant women in the 1st trimester and 50µg/dL in the 2nd and 3rd trimester. Magnitude of zinc deficiency is low if the prevalence of zinc deficiency in a population is <5%, moderate if 5- <10%, moderately high if 10 – 20% and high if >20%.

RESULTS

A total of 16,649 participants from the 7th NNS were included in the study: infants and preschool children (2,370), school children (3,789), adolescents (2,194),

adults (5,797), elderly (1,202), pregnant women (461), and lactating women (836).

Mean serum zinc levels ± SE (95% CI; %CV) and prevalence of deficiency (95% CI; %CV) by age/ population and physiologic groups, by sex are shown in Table 1. The national estimate of zinc deficiency in the Philippines was 30.0% (28.6 – 31.4; 2.3), with a mean serum zinc level of 84.0 ± 0.5 µg/dL (83.0 – 85.0; 0.6). Infants and preschool children presented the lowest prevalence rate (21.6%) among children and the highest mean serum zinc level in all population groups. Boys presented higher prevalence rate than girls both in school-aged (32.6% vs 28.7%) and adolescent (32.2 vs 20.6%) children. While no difference was observed in the overall deficiency rates by gender among adults (31.2 vs 30.7%), elderly men exhibited higher prevalence rate than elderly women (33.6 vs 24.5%). Mean serum zinc level decreased and prevalence of zinc deficiency increased with progressing gestation period. Lactating women presented the lowest mean serum zinc level (72.7 ± 1.1µg/dL) and the highest prevalence of deficiency, 39.7% (36.0 - 43.4) among all population groups, with prevalence rate declining and mean serum zinc level increasing with increasing period of lactation. Women in the 1st 6 months of lactation presented the highest prevalence rate (45.6%) and lowest serum zinc level (69.9 ± 1.3 g/dL). Using the IZiNCG's guidelines for public health concern (Hotz & Brown 2004), the extent of zinc deficiency of Filipinos was generally of high magnitude (>20%), both in the overall estimate and by population and physiologic groups.

Among preschool children, the 5yr-old group and infants <1yr-old presented the highest (24.8%) and lowest (17.0%) prevalence, respectively (Table 2). While no difference was observed in the overall prevalence rate by gender, females in the <1yr and 1yr-old group presented significantly higher prevalence than males, 13.2 % vs 20.7% and 19.3 vs 25.7% (Figure 1), respectively, after which, prevalence rates were predominantly higher among the male preschoolers. Likewise, higher prevalence rates predominated among male school children (Figure 2), except in the 6 and 7 yr-old group where the extent of deficiency were almost similar for both male and female. Highest prevalence rate was noted among the 12 yr-old male (42.0%), followed by the 11 yr-old (37.6%), while the 9 yr-old female exhibited the lowest (25.2%). Disaggregation by age decades among adults did not show differences in the mean serum zinc levels and prevalence of zinc deficiency (Table 3). However, across genders, adult women presented higher prevalence rates in the 20-29 yr and 30-39 yr-old groups, declining to the rate comparable to that of men in the 40-49 yr-old group, after which the extent was remarkably higher in men in the 50 – 59 yr-old group (37.3 vs 29.1%). Older persons ≥ 75 yr presented higher deficiency rate (30.2%) than those in the 60-<75yr-old group (27.9%) (Table 4). Elderly men consistently exhibited significantly higher prevalence rates than women, both in the <75 yr and ≥ 75 yr-old groups.

DISCUSSION

This is the first zinc assessment study using serum zinc as indicator conducted at the national level among all Filipino population groups. Baseline zinc status data generated from this study revealed that zinc deficiency is widespread in all population groups (>20%) in the Philippines and considered of significant public health concern.

Although the extent was considered of high magnitude, zinc nutriture may still be considered relatively low compared to estimates reported in some Asian countries. Zinc deficiency was highly prevalent among preschool children in Vietnam (86.9%) (Nguyen et al. 2008) and India (73.3%) (Dhingra et al. 2009). In North East Thailand, 57.0% of school-aged children had low serum zinc levels (Thurlow et al. 2006), while the 28.1% rate reported in East Iran (Fesharakinia et al. 2009) was relatively close to the 30.8% observed in our study. Zinc deficiency was 49.4% in Indian adolescents (Kapil et al. 2011), 42.5% in Iranian adults (Dabbaghmanesh et al. 2011), and 37.9% in Japanese elderly aged ≥ 60yrs (Kogirima et al. 2007). The use of different cut-off points reported varied results among pregnant women in India: 64.6% (<66 µg) (Pathak et al. 2008), 55.5% (<60µg/dL) (Kapil et al. 2002) and 22.0% (<50µg/dL) (Yasodhara et al. 1996),with the latter closely coinciding with the 21.5% rate (<50µg/dL) obtained in this study. In Vietnam, 55.4% of lactating women had serum zinc level <70 µg/ dL (Nakamori et al. 2009), with the mean serum zinc (68.0 µg/dL) relatively comparable to our results (72.7 ± 1.1 µg/dL). Differences in sampling design, age band or bracket in defining population groups, geographical settings and cut-off points used in the data assessment may have contributed to these wide-ranged differences in zinc status estimates across countries.

Age and sex are two well-established major confounding variables affecting serum zinc concentrations (Hotz et al. 2003). Lowest and highest prevalence observed among <1 yr-old infants (17.0%) and 5 y-old group (24.8%), respectively were in agreement with the findings reported by Dhingra et al. (2009) and Bahijri (2001). Declining zinc status with advancing age was likewise noted among ageing Europeans, although reported deficiency rates were much lower (Sanchez at al. 2005). Vulnerability of males to zinc deficiency is partly attributed to higher growth

Table 1. Mean serum zinc levels of Filipinos and prevalence of zinc deficiency by age/sex/ population and physiologic group.

Age/physiologic group	n	Mean serum Zn ± SE,µg/dL 95% CI; %CV	Cut-off pt (µg/dL)	Zinc deficiency (%) 95% CI; %CV
NATIONAL	16649	84.0 ± 0.5 83.0 – 85.0; 0.6		30.0 28.6 – 31.4; 2.3
Preschool children, 6 mos - < 5 yrs	2370	94.5 ± 0.9 92.7 - 96.3; 1.0	<65	21.6 19.9 – 23.4; 4.1
Male	1265	95.1 ± 1.3 92.6 - 97.5; 1.3		21.6 19.3 – 24.0; 5.6
Female	1105	93.9 ± 1.3 91.3 – 96.5; 1.4		21.6 19.1 – 24.2; 6.0
School children, 6 -12 y	3789	79.9 ± 0.8 78.4 – 81.5; 1.0		30.8 28.4 – 33.1; 3.8
Male	1996	79.3 ± 0.9 77.5 – 81.1; 1.1		32.6 29.8 – 35.4; 4.3
Female	1793	80.6 ± 1.0 78.7 – 82.5; 1.2		28.7 25.9 – 31.5; 4.9
-Adolescents, 13 – 19 y	2194	85.2 ± 0.9 83.5 – 87.0; 1.1		28.9 26.4 – 31.3; 4.2
Male	1208	82.9 ± 1.1 80.8 – 85.1; 1.3	<70	32.2 29.1 – 35.4; 5.0
Female	986	90.9 ± 1.2 88.6 – 93.2; 1.3	< 66	20.6 18.0 – 23.3; 6.5
Adults, 20 -< 60 y	5797	84.2 ± 0.6 82.9 - 85.4; 0.7		31.0 29.1 – 32.9; 3.2
Male	2905	86.9 ± 0.8 85.4 – 88.4; 0.9	74	30.7 28.4 – 32.9; 3.6
Female	2892	81.4 ± 0.7 80.0 – 82.8 ; 0.9	70	31.2 ±1.2 29.0 – 33.5 ; 3.7
Elderly, ≥ 60 yrs	1202	91.4 ± 1.1 89.2 – 93.7; 1.3		28.4 25.7 – 31.1; 4.9
Male	524	90.8 ± 1.8 87.2 – 94.4; 2.0	< 74	33.6 29.3 – 37.8; 6.3
Female	678	91.9 ± 1.43) 89.1 – 94.8; 1.6	< 70	24.5 21.0 – 28.0; 7.3
Pregnant women	461	75.1 ± 1.7 71.8 – 78.5; 2.3		21.5 17.7 – 25.3; 8.8
1st trimester	61	84.1 ± 4.03 76.2 – 92.0; 4.8	< 56	14.4 5.77 – 23.1; 30.5
2nd trimester	211	77.1 ± 2.8 71.6 – 82.6; 3.5	< 50	20.9 15.4 – 26.5; 13.4
3rd trimester	189	69.91 ± 2.26 65.5 – 74.4; 3.2	**< 5**0	24.5 18.3 – 30.8; 12.9
Lactating women	836	72.7 ± 1.1 70.6 – 74.9; 1.5	<66	39.7 36.0 – 43.4; 4.8
1st 6 mos	323	69.9 ±1.3 67.4 – 72.5;1.9		45.6 39.8 – 51.2; 6.4
Next 6 mos	257	71.8 ± 2.2 67.4 – 76.2; 3.1		39.3 32.6 – 45.9; 8.6
>1yr	256	77.3 ± 2.0 73.3 – 81.4; 2.6		32.7 26.1 – 39.3; 10.1

Table 2. Mean serum zinc levels and prevalence of zinc deficiency (<65 µg/dL) among Filipino preschool children by age.

Age	n	Mean serum Zn ± SE,µg/dL 95% CI; CV(%)	Zinc deficiency, % 95% CI; CV(%
All preschool children, 6 mos - < 5 yrs	2370	94.5 ± 0.9 92.7 - 96.3; 1.0	21.6 19.9 – 23.4; 4.1
6 mos < 1 yr	196	96.5 ± 2.8 90.9 – 102.1; 3.0	17.0 11.5 – 22.4; 16.3
1 yr	413	95.2 ± 2.4 90.5 – 100.0; 2.5	22.4 18.2 – 26.7; 9.7
2 yrs	417	93.4 ± 2.2 89.1 – 97.7; 2.3	22.3 18.1 – 26.4; 9.5
3 yrs	412	96.3 ± 2.0 92.4 – 100.3; 2.1	17.6 13.8 – 21.5; 11.0
4 yrs	479	95.3 ± 2.0 91.3 – 99.3; 2.2	22.7 18.8 – 26.6; 8.8
5 yrs	453	91.6 ± 2.1 87.8 – 95.7; 2.3	24.8 20.6 – 29.0; 08.5

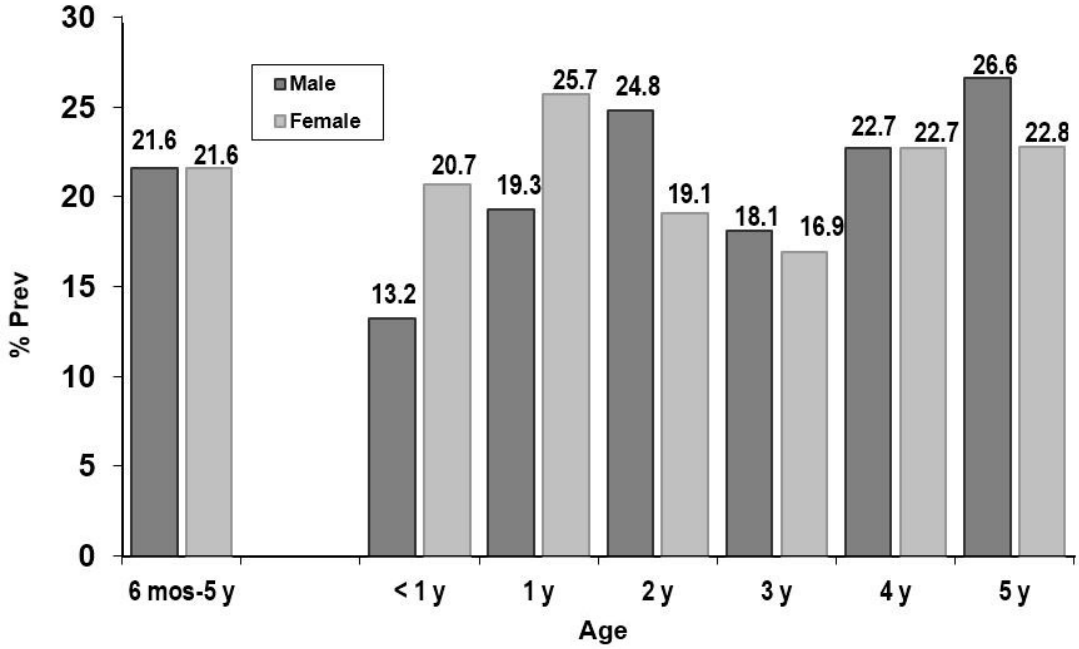

Figure 1. Prevalence of zinc deficiency among Filipino infants/preschool children by single age/sex.

rate and greater proportion of muscle per kilogram body weight as muscle contains a higher content of zinc than fat (Gibson 1994). Prevalence of zinc deficiency was also reported higher in boys than girls (30.6 vs 25.7%) among school-aged children in East Iran (Fesharakinia et al. 2009) and Northeast Thailand (63.6 vs 50.6%) (Thurlow et al. 2006). Lower zinc status noted in male adolescents compared to females coincided with the report in India (50.8% vs 48.2%) (Kapil et al. 2011), but was found in contrast with another study (Hettiarachchi et al. 2006). The low zinc status noted in adult women in the 20 – 29 and 30 – 39 yr-old decades, and which have improved thereafter, may have demonstrated the influence of hormonal status in zinc nutriture of women as cited in another report (Arnaud et al. 2010). Estrogen and progesterone levels are at their highest concentration during ovulatory and luteal phases of the menstrual cycle, setting off the lowest zinc status in women of reproductive age and expected to fall in the menopausal and post menopausal women. Moreover, this may likewise explain better zinc status of women in the older group than men. Elevated risk to zinc deficiency in Japanese male elderly was attributed to ageing (Kogirima et al. 2007), while increasing zinc requirement in males in Australia and New Zealand (NHMRC 2006) has been

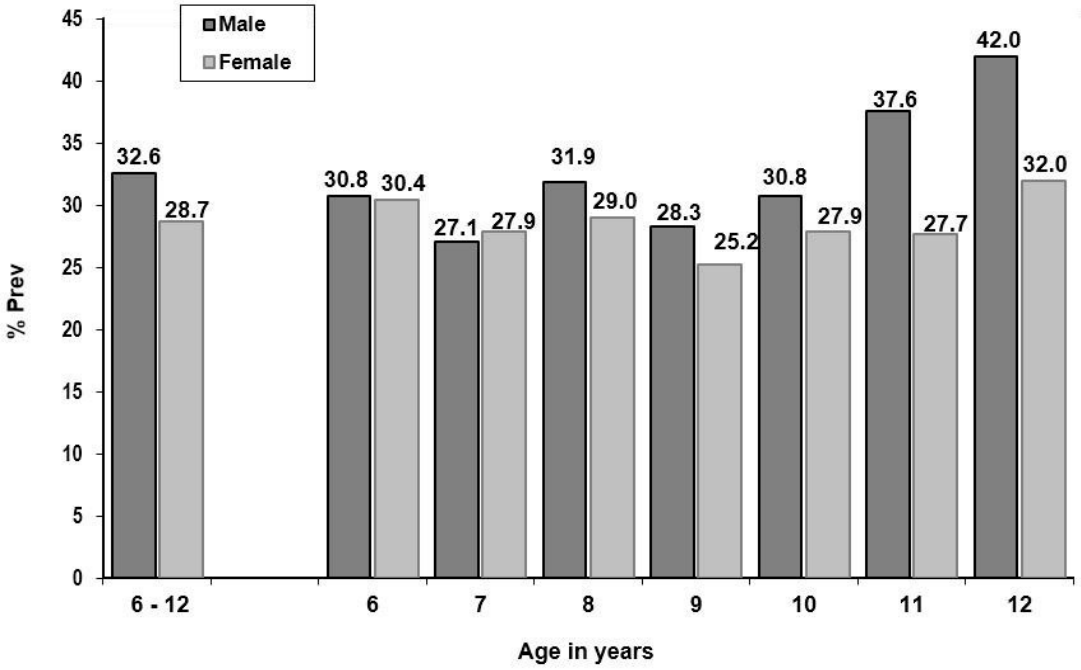

Figure 2. Prevalence of zinc deficiency among Filipino school children by single age, by sex.

Table 3. Mean serum zinc levels and prevalence of zinc deficiency among Filipino adults by age decade, by sex.

Age group	n	Mean serum Zn ± SE, µg/dL95% CI; %CV	Zinc deficiency, % 95% CI; %CV
Adults, 20 -< 60 yr	5797	84.2 ± 0.6 82.9 - 85.4; 0.7	31.0 29.1 – 32.9; 3.2
Male	2905	86.9 ± 0.8 85.4 – 88.4; 0.9	30.7 28.4 – 32.9; 3.6
Female	2892	81.4 ± 0.7 80.0 – 82.8 ; 0.9	31.2 29.0 – 33.5 ; 3.7
20 - 29 yr	1535	86.1 ± 0.8 84.5 - 87.7; 0.8	27.8 25.2 – 30.2; 4.6
Male	847	89.7 ± 1.2 87.4 – 92.0; 1.3	26.3 23.0 – 29.6; 6.5
Female	688	81.9 ± 1.0 79.9 – 83.9 ; 1.2	29.5 25.7 – 33.3 ; 6.4
30 - 39 yr	1529	83.5 ± 1.0 81.6 - 85.3;1.2	32.1 29.3 – 34.9; 4.4
Male	784	86.8 ± 1.2 84.4 – 89.2; 2.3	29.8 26.2 – 33.4; 3.6
Female	745	80.0 ± 1.2 77.7 – 82.4 ; 1.5	34.5 30.8 – 38.1 ; 5.2
40 - 49 yr	1543	83.2 ± 0.9 81.5 - 84.9; 1.1	31.7 29.0 – 34.5; 4.4
Male	750	86.0 ± 1.2 83.6 – 88.4; 1.3	31.8 28.1 – 35.1; 6.0
Female	793	80.5 ± 1.0 78.5 – 82.6 ; 1.2	31.6 28.2 – 35.1 ; 5.7
50 -< 60 yr	1190	83.7 ± 1.1 81.6 - 85.9; 1.3	32.6 29.2 – 36.1; 5.5
Male	524	83.9 ± 1.5 80.9 – 86.9; 0.9	37.3 32.7 – 41.9; 6.1
Female	666	83.6 ± 1.3 81.1 – 86.1 ; 0.9	29.1 24.9 – 33.2 ; 7.2

Table 4. Mean serum zinc levels and prevalence of zinc deficiency among elderly Filipinos by age group,by sex.

Age group	n	Mean serum zn ± SE, *µg/dL* (95% CI; %CV)	Zinc deficiency, % (95% CI; %CV)
Elderly, ≥ 60 yr	1202	91.4 ± 1.1 (89.2 – 93.7; 1.3)	28.4 (25.7 – 31.1; 4.9)
Male	524	90.8 ± 1.8 (87.2 – 94.4; 2.0)	33.6 (29.3 – 37.8; 6.3)
Female	678	91.9 ± 1.4) (89.1 – 94.8; 1.6)	24.5 (21.0 – 28.0; 7.3)
60 - <75 yr	942	92.3 ± 1.3 (89.7 -94.9; 1.4)	27.9 (24.9 – 31.0; 5.4)
Male	418	92.0 ± 2.0 (88.0 – 96.1; 2.2)	32.1 (27.6 – 36.7; 7.2)
Female	524	92.5 ± 1.7 (89.2 – 95.8 ; 1.8)	24.6 (20.7 – 28.4; 8.1)
≥ 75 yr	260	88.3 ± 2.3 (83.7 – 92.8; 2.6)	30.2 (24.4 - 36.0; 9.6)
Male	106	85.5 ± 4.2 (77.1 – 93.9; 4.9)	39.5 (29.8 – 49.2;12.4)
Female	154	90.0 ± 2.6 (84.9 – 95.2; 2.9)	24.3 (17.4 – 31.2; 14.4)

partly due to recognition that absorptive capacity for zinc varies across genders.

Zinc status during pregnancy is normally low (Gibson 1994; Hotz and Brown 2004) as a consequence of blood volume expansion and possibly due to hormonal changes. Serum zinc level progressively declining and zinc deficiency increasing with period of gestation noted in this study coincided with other reports (Tamura et al. 2000; Gebremedhin et al. 2011). Although no difference was noted in serum zinc levels among lactating women in Vietnam, prevalence rates likewise decreased with period of lactation, 61.1% in 6-8 mos and 45.0% in 9-12 mos (Nakamori et al. 2009). Increased nutritional demands during pregnancy and lactation predispose women to developing zinc deficiency, although demands are considered to be greater during lactation than pregnancy (King 2000). Increased zinc absorption reported to nearly two-fold during lactation was likely in response to the demand for zinc to synthesize breast milk (Hotz and Brown 2004).

Although zinc deficiency exists both in developed and developing countries, the degree of risk is expected to be higher in developing countries. This is primarily due to low intake of highly absorbable zinc from flesh foods and high phytate content of the main staples which comprises a high proportion of the population's usual daily intake (Gibson 1994). Increased demands due to physiological processes accompanying each life stage group may likewise intensify risk of deficiency. These include rapid growth in infancy and childhood (Gibson 1994), pubertal growth spurt accompanied with other processes like sexual maturation and onset of menarche in adolescence (Gibson et al. 2002), degenerative changes associated with ageing in older population (Wood et al. 1995), hemodilution and/or hormonal changes in pregnancy (Tamura et al. 2000), and secretion of breast milk in lactation (Gibson 1994).

The quality of the typical Filipino diet (chiefly of plant origin (about 70%) and small fraction of animal source), which closely resembles that in most developing countries, may have contributed to this low zinc status. Low intake of highly absorbable zinc from flesh foods and high phytate content of the main staples comprising high proportion of the population's usual daily intake inhibit zinc absorption and increase the risk of zinc deficiency (Gibson 1994; Solomons & Cousins 1984). Likewise, as proxy indicators for zinc deficiency where data on serum zinc or dietary zinc is not available as suggested by IZiNCG, high rates of stunting among children and the moderately high to high magnitude prevalence of anemia in most population groups may also be indicative of the high magnitude of zinc deficiency among all age groups of Filipinos; although, further investigation and analysis needs to be done. Impaired linear growth is a prominent feature of zinc deficiency among children in both developed and developing countries (Hambidge 2000; Brown et al 2002). There is abundant evidence that stunted children are likely to be zinc deficient (Hotz and Brown 2004). Although iron deficiency does not cause zinc deficiency, both the distribution of iron and zinc and the dietary components

that modify their absorption are similar, suggesting a comparable risk of deficiency (WHO/UNICEF/IAEA/IZiNCG 2007, Hotz and Brown 2004). Several data sets have also demonstrated a significant correlation between anemia and zinc deficiency (Gebremedhin et al. 2011; Hettiarachchi et al. 2006; Hotz & Brown 2004). Where the prevalence of iron deficiency anemia in any age group is considered to be high, further assessments of zinc deficiency are warranted (WHO/UNICEF/IAEA/IZiNCG 2007; Hotz and Brown 2004).

Results of this study suggest an urgency to address the high magnitude of zinc deficiency in the country. IZiNCG has recommended that in a country where prevalence of low serum zinc values exceeds 20%, national level programs may be considered (i.e. either further assessment is indicated or planning for programmatic intervention may be initiated) (Hotz and Brown 2004). To date, very little is being done to control zinc deficiency. There are three major categories of nutrition-focused zinc intervention strategies: supplementation, fortification, and dietary diversification/ modification (Hotz and Brown 2004). Efforts have also been done towards these intervention strategies and current evidences indicate a beneficial impact to eliminate or reduce the risk of zinc deficiency (Brown et al. 2009) yet no policy have been put in place. Supplementation is an essential component of successful strategies to address the problem; however, zinc supplement is only incorporated in the management of diarrhea, both globally (WHO/UNICEF 2004) and locally (DOH A.O. 2007-0045). This study is an important baseline zinc status data at national level and a relevant input for program planners/ policy makers in designing/formulating effective intervention strategies to improve zinc status of Filipinos and likewise a significant contribution in the data base of World Health Organization (WHO) and International Zinc Nutrition Consultative Group (IZiNCG) in assessing the global prevalence of zinc deficiency. Similarly, an in depth analysis to investigate risk factors that may influence zinc deficiency should be carried out and periodic re-assessment should also be done to monitor progress over time.

CONCLUSION

In conclusion, zinc status of Filipinos is generally of significant public health concern (>20%), both at the national level (30.0%) and in the different age/physiologic groups. Lactating women was the most at-risk group to zinc deficiency and males were generally more vulnerable than females.

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