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Evaluation of Calcium Intakes of Young Children in the Philippines as a Result of the 2008 National Nutrition Survey

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Calcium is considered as the most abundant mineral in the body. Milk and other milk products are the best sources of calcium. Calcium deficiency may lead to osteoporosis. This study was conducted to provide information on dietary calcium intakes of young children as basis for advocacy campaigns on keeping watch on their calcium intakes. A total of 5,691 Filipino children aged 6 months to 10 years old were the respondents in the study. The data were taken from the National Nutrition Survey conducted in 2008. Food intakes were collected by face-to-face interviews using 24-hour food recall questionnaires with mothers of children as respondents. Food intake was transformed to nutrient intakes using the Individual Dietary Evaluation System. The mean one-day calcium intake of young children is 291 mg. There was a declining trend from 6 months to 6 years old and slight increases from 7 to 10 years old. Only 14.8% have met the Estimated Average Requirement for calcium. Milk and milk products contributed to about 33.4% of the total calcium intake. The highest calcium intake of young children came from the richest quintile, compared to the groups belonging to the poorest quintile where intake was lowest. Mean and percent adequacy of calcium intake of children and the consumption of milk as rich source of calcium were both very low.

Key words: calcium intake, individual intake, milk and milk products, percent adequacy, socio-economic status, young children

INTRODUCTION

Calcium is the most abundant mineral in the body. The adult human body contains about 1200 g of calcium, equivalent to 1–2 % of body weight (Cashman 2002). It is essential for bone growth and teeth development as it is required for the mineralization of the bone and teeth matrix. The majority (~99%) of calcium present in the body is found in bones, with a smaller amount found in teeth. The remainder (<1%) is found in soft tissues and body fluids (Theobald 2005). This was documented in a longitudinal study by Fiorito et al. (2006) that has strongly linked dietary calcium intake with high total body bone mineral content (TBBMC). Similarly, Tanaka et al. (2014) concluded that a higher calcium intake was significantly associated with lower prevalence of periodontal disease. Aside from its major role in skeletal function, calcium plays a regulatory role in a number of specialized functions in muscle (including cardiac muscle) contraction, neurotransmitter secretion, digestion, and blood coagulation (Theobald 2005; Ehrlich 2011). During growth, an adequate dietary supply of calcium is considered to be critical for the acquisition of strong and healthy bone. If children are to attain their genetic

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potential peak bone mass, their diet must then meet the threshold of calcium needed to satisfy the needs of the skeleton. Accrual of peak bone mass in youth is important for the prevention of osteoporosis in later life (Black et al. 2002).

Worldwide, dietary calcium intakes remained low relative to the varying levels of socioeconomic status and the age groups in critical need of sufficient calcium. Using the U.S. National Health and Nutrition Examination Survey's (NHANES) 2003-2006 data, Bailey et al. (2010) reported that for females, only 15% of 9-13 years old and ≤10% of females aged 14-18, 51-70, and ≥71 years old met the adequate intake level (AI) for calcium from diet alone. No better are males with 22% in 9-13 and 51-70 years old and 15% in ≥71 years old meeting the AI level of calcium from diet alone too. Additionally, another study revealed that adults in more economically advantaged countries typically drank more milk than in their poorer counterpart (Singh et al. 2015). This is in conformity with numerous studies linking poor socioeconomic status with low dietary calcium intake (Islam et al. 2003; Lim et al. 2015).

In the Philippines, calcium intake, regardless of age groups is steadily declining. Based on the 6th National Nutrition Survey (DOST-FNRI 2003), the mean one-day energy calcium intake of preschool children, pregnant women, and lactating mothers was 0.37 g, 0.42 g and 0.41 g respectively. Compared with the 7th National Nutrition Survey (DOST-FNRI 2008), these decreased to 0.33 g, 0.39 g, and 0.37 g, respective of the aforementioned population groups. Furthermore, only 11.5% of the total households surveyed in 2008 met 80% of the Recommended Energy and Nutrient Intake (DOST-FNRI 2002) for calcium and more than 70% of Filipinos across population groups are deficient in calcium in their daily diet.

Sources of calcium include milk and milk products, fishes, especially the small fishes eaten with bones (e.g. anchovies and sardines), soy bean curd or tofu, small shrimps, broccoli, and dark green leafy vegetables. Milk and other milk products offer high calcium bioavailability and have high calcium content relative to their nutritional value (Bhatia 2008). The Nutritional Guidelines for Filipinos recommend consuming four tablespoons of powdered milk or one glass of liquid milk of 240 mL, milk products and other calcium-rich foods for strong bones (Food and Nutrition Research Institute-Department of Science and Technology 2012). The Philippine Dietary Reference Intakes' (PDRI 2015) recommended daily nutrient intakes (RNI) of calcium among 6 to less than 12 month infants is 400 mg, among 1-2 year old children is 500 mg, among 3-5 year old children is 550 mg, among 6-9 year old children is 700 mg and among 10-12 year old children is 1000 mg (FNRI-DOST 2015).

Over the long term, intakes of calcium below recommended levels increase the risks of osteoporosis and bone fractures. Osteoporosis has been called the "pediatric disease with geriatric consequences" (National Institutes of Health 2015). Accordingly the International Osteoporosis Foundation's Asian Audit (2009) reported that the incidence of hip fracture has risen two- to three-fold in most Asian countries over the past 30 years. Children need sufficient calcium to support an accelerated growth spurt during the pre-teen and teenage years. In addition, during this time, their bodies are in opportune need of meeting adequate calcium levels to attain peak bone mass, which will have a tremendous impact on their bone density during their older years particularly between 49 to 66 years of age (Nicklas 2003).

This evaluation study aimed to analyze calcium intake of Filipino children and determine the contribution of milk and milk products to calcium intakes of children by age and socioeconomic status whose parents were respondents in the 2008 National Nutrition Survey to provide comprehensive information on dietary calcium intakes of young children.

The results of this study will assist future intervention programs since this may serve as base information in crafting programs to increase the calcium status of young and older children in different socioeconomic strata.

MATERIALS AND METHODS

Study Design and Participants

The 7th National Nutrition Survey was conducted by the Department of Science and Technology–Food and Nutrition Research Institute (DOST-FNRI) in 2008 which utilized the Philippine Statistics Authority, formerly known as National Statistics Office (NSO), 2003 master sample in employing a stratified multi-stage sampling design. The first stage was the selection of primary sampling unit which is a barangay or contiguous barangays with at least 500 households. The second stage was the selection of enumeration areas which are contiguous areas in a barangay with 150-200 households, and the third stage was the selection of households. The 2003 master sample consisted of four replicates. A replicate is defined as a sub-sample that possesses the properties of the full master sample which is able to generate national level estimates of adequate precision.

The stratified multi-stage sampling survey that embodies the 7th NNS (DOST-FNRI 2008) investigated all 17 regions of the Philippines which included 79 provinces and the National Capital Region. A total of 36, 634

households and 191, 316 individuals were interviewed and subjected for data collection. The dietary assessment was one of the seven major components that comprised the overall results of the 7th Philippine National Nutrition Survey which also included results on the following: anthropometry, biochemical nutrition, clinical nutrition and health survey, government program participation, and socio-economics and food insecurity survey.

The dietary assessment component utilized 50% of one replicate permitting national estimates. All members of the sampled households were included in the survey requiring individual data. A total of 5,691 children aged 6 months to 10 years old served as the sample subjects for this study. Dietary data was collected by trained nutritionist-dietitians using the 24-hour food recall method and was conducted through the Multiple Pass Method (MPM), a five-stage guided interview that improves the precision of the 24-hour food recall method (Moshfegh et al. 2008). The stages consist of (1) quick list of foods; (2) forgotten food list by eliciting additional recall of foods by focusing respondent's attention on 9 categories of foods that are often forgotten; (3) recalling the time and occasion the respondent ate each food and the name of the eating occasion; (4) collection of detailed description of food including amount, cooking methods, brand names, additional ingredients, and location where it was eaten; and (5) final review probe. Research assistants were trained according to the 2008 National Nutrition Survey implementation protocols.

Individual 24-hour food recall data for two non-consecutive days were obtained through face-to-face interviews using structured questionnaires for mothers or caregivers of 6 month - 5 year old children. On the other hand, 6-10 year old children were interviewed in the presence of their parent or guardian to confirm their answers. Food intake was recalled starting from the time the child woke up in the morning until the time he/she slept at night including in-between meals and midnight snacks. In most cases, most food items recalled were cooked state except for some foods that are conventionally eaten fresh and raw. Amounts are in household measures such as cups and tablespoons or by size and number of pieces.

Food models or pictures were used as aides in estimation, description, and proper identification of food items or serving portions. Rulers were also used to estimate sizes given through mere gestures. A structured questionnaire was used as guide for the interview.

In translating the recalled amounts of consumed food into weights, the Standard Weights and Measures and List of Substitutes and List of Fishes developed by FNRI-DOST were used. In addition, sample weighing and market surveys (part of the 7th National Nutrition Survey), were conducted. Calcium intake in this study covered all dietary food sources of calcium including cow's milk but not breastmilk. Breastmilk was not included in the calculation of calcium intake due to the difficulty in interviewing mothers on the frequency and duration the infant is put to the breast during the previous 24 hours.

After translating food consumption data into weights, individual 24-hour food recall data were converted to As Purchased/ Edible Portion (AP/EP) values using the Individual Dietary Evaluation System (IDES) developed by DOST-FNRI with reference to Philippine Food Composition Library as its nutrient database (DOST-FNRI 2008). The Individual Dietary Evaluation System (IDES) is a computer software that was used to generate individual nutrient intakes based on the weight of consumed foods. The same software was also used to determine and compute the amount and kinds of nutrients in dietary intakes. A manual test run was done for a few households to compare the results of the IDES before the actual run on the computer system. After the nutrients of each food were identified and quantified by the IDES, the nutritional value and adequacy of the dietary intakes were then evaluated by comparing these with the PDRI's Recommended Nutrient Intakes (RNI) and Estimated Average Requirement (EAR) (DOST-FNRI 2015). The Recommended Nutrient Intakes refer to the levels of intakes of nutrients which, on the basis of current scientific knowledge, are considered adequate for the maintenance of good health and well-being of nearly all healthy Filipinos. Estimated Average Requirement (EA) refers to the daily nutrient intake level that meets the median or average requirement of healthy individuals in a particular life stage and sex group, corrected for incomplete utilization or dietary nutrient bioavailability (DOST-FNRI 2015). Analysis of the data was made using the SPSS Statistics software version 15 while tables were produced using the Stata software version 7.

Statistical Analyses

Descriptive statistics, specifically means and percentages, were calculated for assessing the dietary calcium intake and percent contribution of milk and milk products to calcium intake of young children aged 6 months to 10 years old. The percent adequacy of calcium intake per age group and the number of children meeting the RNI and EAR for calcium were calculated by comparing the actual intake and the calcium requirement per age group based on PDRI (DOST-FNRI 2015).

Wealth quintiles based on the socio-economic status were divided into five data sets to stratify the distribution of calcium intake of young children (Rutstein and Johnson 2004). Twenty-fifth (25^{th}), 50^{th}, and 75^{th} percentiles of calcium intakes were presented to further describe the

wealth quintile distribution. The children's age was categorized in years and in months in relation to different wealth quintiles to assist in the targeting of future nutrition interventions.

RESULTS AND DISCUSSION

Calcium intake of young children

The mean one-day calcium intake of young children aged 6 to 11 months old by single age group was 446 mg. It can be observed that children under the age group 6 to 11 months had the highest mean calcium intake (446 mg) although this was not statistically significant when compared with 6 to 9 years old children who had the lowest (248 mg) intake. About 44.6% of the children aged 6 to 11 months old met the Estimated Average Requirement. The percentage of children meeting the EAR decreased as age increased. The lowest percentage (7.6%) was observed among children aged 6-9 years old. For children meeting at least 80% of the Recommended Nutrient Intake (RNI), on the other hand, the highest percentage was observed among children aged 6 to 11 months. This was significantly different from that of children aged 10 years old and onwards which had the lowest percentage (Table 1).

The recommended calcium intake for 6-11 months old is 400 mg. In this study, only 39.5% and 45.2% met 100% and 80% of the Recommended Nutrient Intake (RNI) respectively. On the other hand, only 44.6% met the Estimated Average Requirement (EAR). Moreover, the 6 months to 1 year old only met about 30% of the requirement or a third of the recommended RNI, which is statistically different from the other age groups. The percentage mean adequacy levels in the different age groups decreased as the age of the children increased. For children aged 6 years to 10 years, the mean percentage adequacy when compared with both the EAR and RNI was below 10% (Table 1).

Contribution of milk and milk products

Milk and milk products have contributed to about 86.7% (387.0 mg) and 80.2% (343.6 mg) of the calcium intake of children aged 6 to 11 month old and 1 year old, respectively. The contribution of milk and milk products to the calcium intake of children decreased as children grew older. The percentage contribution of milk and milk products to the calcium intake of children was lowest when the child reached 9 to 10 years old. The type of milk that was commonly cited and had contributed the highest source of calcium intake of children in all age groups was powdered milk. It contributed to about 1/3 or 33.4% of the total calcium intake (Table 2).

Calcium intake based on socio-economic status

Tables 3 - 5 show the distribution of calcium intake of children from infancy and toddlers to school age divided according to years and months. The 1st quintile represents the poorest group of children while the 5th quintile belongs to the most affluent group. In all tables, across wealth quintiles, children under the 25th percentile in all age groups have the lowest calcium intake. Across age groups, infants and toddlers (6 – 23 months), in all tables, under the 25th percentile of the 1st to the 4th wealth quintiles have the lowest calcium intake. Intake increased as children reached school age. This observation, however, does not apply to children under the 25th percentile of the 5th

Table 1. Mean one-day calcium intake of young children aged 6 months – 10 years old by single age group: Philippines, 2008.

Age	Calcium Intake (mg)	Meeting Adequacy Level by:		
		EAR[a]	80% RNI[b]	100% RNI[b]
	Mean (Standard Error)	Mean (Standard Error)	Mean (Standard Error)	Mean (Standard Error)
6 to 11 months	446 (36.4)	44.6 (3.4)[c]	45.2 (3.4)[d]	39.5 (3.3)[d]
1 – 2 year	388 (16.2)	28.0 (1.6)[d]	32.8 (1.6)[d]	35.3 (1.5)[d]
3 – 5 years	271 (7.7)	13.5 (1.0)[d]	13.6 (1.0)[d]	9.9 (0.8)[d]
6 – 9 years	248 (3.5)	7.6 (0.6)	2.7 (0.3)	1.5 (0.3)
10 – 10.99 years	277 (9.2)	10.3 (1.3)	1.5 (0.6)	0.6 (0.4)
ALL	**291 (4.9)**	**14.8 (0.6)**	**12.6 (0.5)**	9.4 (0.4)

[a] EAR-Estimated Average Requirement
[b] RNI-Recommended Nutrient Intake
[c] No EAR value was offered by PDRI. EAR value was computed by dividing RENI (2002) 400 mg requirement by 1.2 conversion factor (WHO)
[d] Statistically significant

Table 2. Percentage contribution of milk and milk products to calcium intake of 6 months – 10 years old and by single age group: Philippines, 2008.

Food Group/ Subgroup	Contribution of Calcium by single age																					
	6 to 11 mo		1 year old		2 years old		3 years old		4 years old		5 years old		6 years old		7 years old		8 years old		9 years old		10 years old		ALL	
	Intake	%	Intake	%	Intake	%	Intake	%	Intake	%	Intake	%	Intake	%	Intake	%	Intake	%	Intake	%	Intake	%	Intake	%
Milk & Milk Products	387	86.7	343.6	80.2	211.3	60.8	133.8	43.9	86.2	32.5	56.5	22.9	33.1	14	28.9	11.8	29.2	11.6	17.6	6.8	18	6.5	**103.8**	**35.7**
Milk																							100	34.4
Fresh whole milk	0	0	0.5	0.1	0	0	0.5	0.2	3.5	1.3	0.2	0.1	1.1	0.5	2.9	1.2	0.3	0.1	0.3	0.1	0.7	0.3	**1**	**0.3**
Evap milk,filled, recomb & whole	0.2	0.03	0.5	0.1	1	0.3	1.5	0.5	1.5	0.6	2.6	1	1.2	0.5	2.3	0.9	1.1	0.4	1.5	0.6	1.5	0.5	**1.4**	**0.5**
Powdered milk	386.7	86.6	338.9	79.1	207.6	59.8	127.2	41.7	75.5	28.5	49.3	19.9	26	11	19.3	7.9	23.1	9.2	10.6	4.1	11.4	4.1	**97.2**	**33.4**
Infant Formula	283.4	63.5	63	14.7	31.3	9	2.8	0.9	4.5	1.7	3.2	1.3	0.7	0.3	1.5	0.6	0	0	0	0	0.02	0.01	22.4	7.7
Whole/Full cream	22.6	5.1	152.7	35.6	93.1	26.8	42.9	14.1	33.2	12.5	11.8	4.8	7.5	3.2	2.3	1	6.4	2.5	1.4	0.5	2.6	0.9	**32.4**	**11.1**
Filled milk	80.6	18.1	122	28.5	82.2	23.7	80.3	26.4	36.7	13.8	33.6	13.6	15.5	6.6	15.1	6.2	16.5	6.6	9.1	3.5	8.1	2.9	**41.5**	**14.3**
Skimmed milk	0.1	0.02	1.3	0.3	1	0.3	1.2	0.4	1.1	0.4	0.7	0.3	2.4	1	0.4	0.2	0.3	0.1	0	0	0.6	0.2	**0.8**	**0.3**
Condensed milk	0	0	0.6	0.1	0.7	0.2	0.2	0.1	0.8	0.3	0.7	0.3	0.2	0.1	0.3	0.1	0.7	0.3	0.4	0.2	0.3	0.1	0.5	0.2
Milk products																							**3.8**	**1.3**
Cheese	0	0	0.1	0.02	0.2	0.04	0.9	0.3	0.6	0.2	1.2	0.5	1.2	0.5	1.6	0.7	1.3	0.5	2.1	0.8	1.3	0.5	**1**	**0.4**
Other milk products	0.1	0.02	2.9	0.7	1.8	0.5	3.4	1.1	4.2	1.6	2.6	1	3.4	1.4	2.4	1	2.6	1.1	2.6	1	2.9	1	**2.8**	0.9

Table 3. Distributions of calcium intake of young children aged 6 months – 10 years old by single age group by wealth quintile: Philippines, 2008.

Age	Sample size (n)	1st wealth quintile			2nd wealth quintile			3rd wealth quintile			4th wealth quintile			5th wealth quintile		
		Total Calcium Intake by Percentile														
		25th	50th	75th	25th	50th	**75th**	**25th**	**50th**	**75th**	**25th**	**50th**	**75th**	**25th**	**50th**	**75th**
6-11 months	**261**	12.7	30.1	184.7	19.4	80.6	671.0	90.7	394.6	726.2	90.7	406.5	945.8	294.9	595.6	1055.8
1 – 1.99 year	**501**	53.9	97.0	178.7	97.5	193.3	492.8	157.1	428.8	690.0	215.2	545.5	1011.8	379.5	643.5	867.2
2 – 2.99 years	**487**	88.4	141.0	188.3	125.5	203.8	352.3	153.1	258.3	432.1	215.0	382.8	694.4	194.4	362.2	578.7
3 – 3.99 years	**486**	87.0	128.4	206.2	141.1	215.6	318.5	135.4	208.9	349.0	169.9	300.7	633.2	259.0	463.8	826.8
4 – 4.99 years	**549**	104.1	143.9	187.6	128.2	181.1	267.0	155.3	221.1	326.1	189.4	300.0	417.2	243.9	333.1	556.5
5 – 5.99 years	**531**	106.2	145.2	214.8	135.6	202.9	255.4	152.5	203.2	304.8	178.9	246.1	404.1	231.3	348.4	408.5
6 – 6.99 years	**521**	132.1	174.5	248.1	134.8	197.1	259.0	138.9	208.6	263.5	181.8	255.0	361.5	199.7	329.7	433.7
7 – 7.99 years	**578**	121.4	176.4	244.9	144.7	191.7	266.4	162.4	230.0	302.0	180.4	241.2	344.7	199.9	261.3	455.7
8 – 8.99 years	**638**	138.2	183.4	264.4	154.5	216.2	295.0	168.4	215.7	286.2	205.5	290.0	379.3	196.9	276.0	392.3
9 – 9.99 years	**538**	140.4	191.9	259.5	160.1	227.3	302.9	173.3	233.1	306.1	201.7	265.0	357.7	240.5	322.9	409.6
10 – 10.99 years	**601**	152.4	221.5	293.1	167.3	220.8	287.0	190.1	244.5	341.0	206.2	264.5	319.3	226.7	335.2	450.0
TOTAL	**5,691**	110.7	162.3	237.6	136.2	204.7	299.6	154.9	230.0	349.8	191.9	280.4	439.3	231.0	351.8	534.3

Table 4. Distribution of calcium intake of young children aged 6 months – 10 years old into 5 age groups by wealth quintile: Philippines, 2008.

Age	Sample size (n)	1st wealth quintile			2nd wealth quintile			3rd wealth quintile			4th wealth quintile			5th wealth quintile		
		Total Calcium Intake by Percentile														
		25th	50th	75th	25th	50th	75th	25th	50th	75th	25th	50th	75th	25th	50th	75th
6-23 months	**1,678**	27.4	84.9	184.7	65.9	177.6	522.0	128.1	415.4	723.4	171.1	490.1	1005.8	379.5	618.4	879.1
24-47 months	**1,567**	87.0	129.8	190.0	128.5	213.3	328.1	148.1	236.4	400.4	188.9	327.2	668.0	242.6	417.9	676.7
48-71 months	**1,105**	105.6	144.9	201.3	132.6	186.6	267.0	153.7	217.3	315.1	188.3	261.7	407.8	241.7	348.2	526.4
72-95 months	**911**	130.3	174.5	245.4	140.0	193.4	261.6	148.3	215.9	290.8	180.4	242.2	359.0	199.9	283.7	439.5
96-131 months	**430**	144.2	199.7	274.6	162.3	223.3	296.0	176.2	228.6	317.8	205.5	272.7	352.8	226.7	313.5	409.6
TOTAL	**5,691**	110.7	162.3	237.6	136.2	204.7	299.6	154.9	230.0	349.8	191.9	280.4	439.3	231.0	351.8	534.3

Table 5. Distribution of calcium intake of young children aged 6 months – 10 years old by old in months and by wealth quintile: Philippines, 2008.

Age	Sample size (n)	1st wealth quintile			2nd wealth quintile			3rd wealth quintile			4th wealth quintile			5th wealth quintile		
		Total Calcium Intake by Percentile														
		25th	50th	75th	25th	50th	75th	25th	50th	75th	25th	50th	75th	25th	50th	75th
Infants & Toddlers 6-23 months	**1,678**	27.4	84.9	184.7	65.9	177.6	522.0	128.1	415.4	723.4	171.1	490.1	1005.8	379.5	618.4	879.1
Pre-school children 2-5.99 years	**2,672**	97.9	139.0	196.9	130.5	198.3	297.4	151.5	221.1	341.5	188.3	283.1	508.7	242.3	359.1	583.3
School-age 6-10.99 years	**1,341**	138.0	186.8	261.7	151.8	212.3	284.6	162.3	225.0	305.3	195.2	266.7	354.1	214.1	308.2	421.6
TOTAL	5,691	110.7	162.3	237.6	136.2	204.7	299.6	154.9	230.0	349.8	191.9	280.4	439.3	231.0	351.8	534.3

wealth quintile where infants and toddlers have the highest calcium intake which decreased as children reached school age. Generally, calcium intake was higher among children in the higher socio-economic strata across quintiles and age groups (Table 3-5).

DISCUSSION

The 7th NNS (2008) data were analyzed to determine the dietary calcium intake among young children and how this correlates with wealth quintiles to facilitate clearer targeting and planning of future interventions. Calcium is a major component of the skeleton and its importance to human health extends beyond its contribution to healthy and strong bones but the quality of life too. Since milk is a good source of calcium, this study also focused on the consumption of milk as a form of calcium intake.

From children aged 6 months to 10 years old, only 14.8% of the children met the estimated average requirement for calcium (Table 1). The age groups that have met at least 30% or 1/3 of the RNI were the 6-11 months and 1 year old attributable to their high consumption of milk and milk products amounting to 86.7% and 80.2% respectively (Table 2). It was also noted that parallel to the reduction of calcium intake with increasing age is the declining contribution of milk and milk products to calcium intake as the child grows older. A similar study showed that calcium intake from fluid milk decreased with an increase in age (Alexy and Kersting 2003). Calcium intake followed similar patterns to milk intake since ruminant milks are among the richest sources of dietary calcium when expressed as a percentage of weight consumed. For instance, cow's milk contains approximately 120 mg Ca/100 g (Holick 2002). The declining trend observed between calcium and milk intake and increasing age can be explained by two factors: the gradual onset of lactose intolerance and an increased preference for coffee and tea (28.24 – 28.74%), chocolate-based beverages (25.31% – 26.38%), and softdrinks (16.20 – 16.73%) by 6-12 years old Filipino children (Golloso-Gubat et al. 2015). Lactose intolerance (LI) is a clinical syndrome caused by lactase deficiency that affects 50-100% of Asians, approximately 20% of whom are children (Sahi 1994; Heyman 2006). Although threshold values for LI are highly individualized

and dependent of genetic endowment, Nicklas (2003) cited that majority of the incidence rates for LI represent the proportion of people who are diagnosed with lactose maldigestion after consuming a challenge dose of lactose in water (50 grams). Since milk and milk products contain considerable amounts of lactose, its ingestion by children with LI can lead to clinical discomfort such as abdominal pain, diarrhea, nausea, flatulence, and/or bloating (Heyman 2006). These experiences can torment children and decrease their chances of milk and milk-product consumption.

On the other hand, similar studies had reported the increasing preference for soft drinks, coffee, and chocolate-based beverages of growing children in exchange of milk and milk product consumption (Fulgoni III & Quann 2012; Barquera et al. 2010). Milk provides high calcium content and bioavailability therefore a gradual and increasing shift towards soft drinks consumption among children and adolescents suggest the displacement of more nutritious beverages (Nicklas 2003). Soft drink intake is strongly associated with a higher level of energy intake than is stated in the nutritional label. This raises the possibility that soft drinks increase hunger, decrease satiety, or simply calibrate people to a high level of sweetness that generalizes to preferences in other foods (Vartanian et al. 2007). Moreover, soft drink consumption was also related to higher intake of carbohydrates, lower intakes of fruit and dietary fiber, and lower intakes of a variety of macronutrients (Vartanian et al. 2007). Additionally, the increase in coffee consumption in young children is reflective of the increase intake of caffeine. Caffeine is a psychoactive drug used as a stimulant to arouse the central nervous system. Caffeinated beverage consumption in general, and soda consumption in particular, are of concern because of their potentially negative health effects as well as the established relationship with sleep dysfunction, obesity, and dental caries (Temple 2009).

Aside from the observed trend of lowered calcium and milk and milk product intake relative to a child's increase in age, calcium intakes had been alarmingly and steadily declining throughout the years. Compared with the 6th National Nutrition Survey (2003), the mean one-day calcium intake of preschool children is 370 mg as opposed to 7th NNS result of the same age group 330 mg). Lowered calcium intakes can be deleterious because these might have a negative implication on bone density which is one of the major predictors of osteoporotic fractures in both children (Specker 2002; Jones 2011) and the elderly (Specker 2002; Flynn et al. 2007). It is usually accepted that increasing calcium intake during childhood and adolescence will be associated with greater gain in bone mass and thereby a higher peak bone mass (Cooper 2003). According to the International Osteoporosis Foundation's Asian Audit (2009), the incidence of hip fracture has risen two- to three-fold in most Asian countries over the past 30 years. Filipino women are more likely to develop osteoporosis because their bones are thinner than those of their Caucasian counterparts (Mithal et al. 2009). The belief that osteoporosis is prevalent in Western countries and rare in Asia, including the Philippines is conceptually inappropriate. This was validated by the Fracture Projections by the World Health Organization (WHO) which indicated that by 2050, more than 50% of all osteoporotic hip fractures will occur in Asia.

A previous study has identified that the risk factors for osteopenia during childhood were low intake of milk, fresh fish, and green leafy vegetables (*Villadolid et al. 2002*). One study found that milk intake in childhood (≤ 12 yr) was independently related to spine and hip BMD in women aged 45–49 yr (Kalkwarf et al. 2003). Conversely, in an efficacy study among Filipino schoolchildren aged 6 to 8 years old, drinking milk resulted to increased total bone mineral content and total bone mineral density among children over a 12-month period (Villadolid et al. 2002). Conflicting results could be due to differences in methodological approaches and sample characteristics. The Nutritional Guidelines for Filipinos recommend the consumption of one glass of milk, milk products, or other calcium-rich foods to help meet the requirements for calcium (DOST-FNRI 2012). Calcium absorption from plant sources is considered to be low compared to animal sources because of the chelation properties of phytates and oxalates present in a plant-based diet (Holick 2002). Based on the 2008 National Nutrition Survey, the mean one-day calcium intake of young children is 291 mg which is only 12.6% adequate when compared with the 80% requirement of the same age group. According to a study of among women ≥50 years of age, those with low milk intake during childhood had a two-fold greater risk of fracture than did women with high milk intake during childhood, and this greater risk could account for 11% of osteoporotic fractures in this population. A study also indicated that women who reported drinking milk with every meal during childhood and adolescence had significantly higher bone densities than women who reported drinking milk less frequently (Cooper 2003).

It should be considered, however, that increased calcium intake is not the only panacea for osteoporosis prevention. Bone-related variables are influenced by exercise and diet and the combination of these two factors. Julian-Almarcegui et al. (2015) stated that the effect of exercise plus increased calcium intake on increasing bone mass was greater than the effect of either exercise or calcium intake alone. Furthermore the same study also noted, though results were inconsistent due to methodological discrepancies, that a minimum calcium intake is necessary

in order to observe a positive effect of physical activity on bone mass.

Effect of socio-economic status on calcium intake

An increase in wealth quintile status per age group is directly proportional to an increase in total calcium intakes (Tables 3 – 5). In the 25th percentile or the lowest quintile of the 6-11 months old group, calcium intake was 12.7 mg per day. In the next four quintiles of the same age group and percentile, the intakes were 19.4 mg, 90.7 mg, 90.7 mg and 294.9 mg, respectively (Table 3). This is consistent with a recent study in Korea where calcium intakes and dietary quality of calcium were lowest in the low household income group and was significantly lower in regions with lower socioeconomic status (Lim et al. 2015). It is logical to think that part of the social inequalities in health could be associated with lower intake of calcium among low income families. Impoverished families are incapable of meeting adequate nutrient intakes, regardless of the age group concerned, through independent or synergistic mechanisms of financial limitations, nutritional education deficit, and food insecurity. Though milk and milk products provide greater amounts of readily-absorbed dietary calcium, these products are generally beyond the reach of the poor (Islam et al. 2003). In a study between two socioeconomic groups in Bangladesh, it was revealed that the main sources of calcium in the low-income group were cereals, vegetables, and fish whereas the sources in the high-income group were fish, milk products, and cereals (Islam et al. 2003). The promotion of high-cost foods to low-income people without taking food costs into account is not likely to be successful. Milk and milk products are costly, therefore promotion and consumption of other rich sources of calcium that are cheaper and accessible to low income groups such as soy bean curd, small shrimps, green leafy vegetables like horseradish and mustard leaves, and fishes eaten with bones like dilis (anchovies) and sardines should be sought and taught nationwide, reaching all segments of the population. Since offsetting the limiting influence and crippling effect of low socioeconomic status, specifically household income, on health and nutrition status requires strong poverty reduction programs, key reforms on national economic and social development policies, and time, immediate interventions focusing on enhancing nutrition education among low-income and vulnerable groups, planned dietary interventions, and bolstering the efficacy and reach of complimentary health and nutrition services should be given attention to help increase calcium intake in population groups consuming it the least but needing it the most.

CONCLUSIONS AND RECOMMENDATIONS

The analysis of the dietary assessment component of the 2008 National Nutrition Survey revealed that the mean and percentage adequacy of calcium intake of children was very low. Calcium and milk and milk product intake was lowest among the lowest segment of socio-economic stratum. Furthermore, milk and milk product intake declines with increasing age. This study warrants future researches on the assessment of main sources of dietary calcium per socioeconomic group and the relationship between diet quality, nutrient intake, and other demographic characteristics of various population groups. Findings of this study may be used to effectively target population groups with inadequate calcium and milk and milk product intake; to create, tailor and deliver appropriate and timely nutrition intervention programs through strong national government support and sustainable collaborations between the public and private sector; to develop localized integration of nutrition programs through the involvement of parents, local health units, stakeholders, program managers, and policymakers; and, to address cost reduction of milk and milk products by industries.

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REFERENCES

ALEXY U, KERSTING M. 2003. Time trends in the consumption of dairy foods in German children and adolescents. European Journal of Clinical Nutrition 57: 1331-1337.

BAILEY RL, DODD KW, GOLDMAN JA, GAHCHE JJ, DWYER JT, MOSHFEGH AJ, SEMPOS CT, PICCIANO MF. 2010. Estimation of total usual calcium and vitamin D intakes in the United States. J Nutr 140: 817–822.

BARQUERA S, CAMPIRANO F, BONVECCHIO A, HERNANDEZ-BARRERA L, RIVERA JA, POPKIN BM. 2010. Caloric beverage consumption patterns in Mexican children. Nutrition Journal 9 (47): 1-10.

BHATIA V. 2008. Dietary calcium intake – a critical reappraisal. Indian J Med Res 127(3): 269-273.

BLACK R, WILLIAMS S, JONES I, GOULDING A. 2002. Children who avoid drinking cow milk have low dietary calcium intakes and poor bone health. Am J Clin Nutr 76:675-680.

CASHMAN KD. 2002. Calcium intake, calcium bioavailability and bone health. British Journal of Nutrition 87 (2): S169–S177.

COOPER C. 2003. Epidemiology of osteoporosis. In Favus MJ, editor. Primer on the metabolic bone diseases and disorders of mineral metabolism, 5th Edition. Washington: American Society for Bone and Mineral Research. p. 307-313.

EHRLICH SD. Calcium. University of Maryland Medical Center. Retrived from http://www.umm.edu/altmed/articles/calcium-000290.html. on April 2011

FIORITO LM, MITCHELL DC, SMICIKLAS-WRIGHT H, BIRCH LL. 2006. Girl's calcium intake is associated with bone mineral content during middle childhood. The Journal of Nutrition 136 (5): 1281-1286.

FLYNN J, FOLEY S, HONES G. 2007. Can bone density assessed by DXA at age 8 predict fracture risk during puberty? An eight year prospective study. J Bone Miner Res 22:1463-1467.

[DOST-FNRI] Food and Nutrition Research Institute, Department of Science and Technology. 2002. Recommended Energy and Nutrient Intake, 2002 Edition. Taguig City, Philippines. 423p.

[DOST-FNRI] Food and Nutrition Research Institute - Department of Science and Technology. 2003. 6th National Nutrition Survey 2003. Taguig City, Philippines. p29.

[DOST-FNRI] Food and Nutrition Research Institute, Department of Science and Technology. 2008. Food Composition Table Library, Updated 2008 Edition. Taguig City, Philippines.163p.

[DOST-FNRI] Food and Nutrition Research Institute - Department of Science and Technology. 2012. Nutritional Guidelines for Filipinos, Revised Edition 2012. Taguig City, Philippines.149p.

[DOST-FNRI] Food and Nutrition Research Institute - Department of Science and Technology. 2015. Philippine Dietary Reference Intakes. Taguig City, Philippines. 25p.

FULGONI III VL, QUANN EE. 2012. National trends in beverage consumption in children from birth to 5 years: analysis of NHANES across three decades. Nutrition Journal 11 (92): 1-11.

GOLLOSO-GUBAT MJ, MAGTIBAY EVJ, GIRONELLA GMP, TAJAN MG, CONSTANTINO AS. 2015. Beverage consumption of Filipino children and adolescents (7th National Nutrition Survey): nutritional concerns and potential policy implications. Philippine Journal Science 144 (1): 31-41.

HEYMAN MB. 2006. Lactose Intolerance in infants, children, and adolescents. Pediatrics 118 (3): 1280-1286.

HOLICK MF. 2002. Calcium and vitamin D in human health. Annales Nestle 60:83-93.

ISLAM MZ, LAMBERG-ALLARDT C, KARKKAINEN M, ALI SMK. 2003. Dietary calcium intake in pre-menopausal Bangladeshi women: do socio-economic or physiological factors play a role? Eur J of Clin Nutr 57:674-680.

JONES G. 2011. Early life nutrition and bone development in children. Nestle Nutr 68:227-236.

JULIAN-ALMA´RCEGUI C, GOMEZ-CABELLO A, HUYBRECHTS I, GONZALEZ-AGUERO A, KAUFMAN JM, CASAJUS JA, VICENTE-RODRIGUEZ G. 2015. Combined effects of interaction between physical activity and nutrition on bone health in children and adolescents: a systematic review. Nutrition Reviews 73 (3):127–139.

KALKWARF HJ, KHOURY JC, LANPHEAR BP. 2003. Milk intake during childhood and adolescence, adult bone density, and osteoporotic fractures in US women. Am J Clin Nutr 77:257–65.

LIM HS, PARK YH, LEE HH, KIM TH, KIM SK. 2015. Comparison of calcium intake status by region and socioeconomic status in Korea: The 2011-2013 Korea National Health and Nutrition Examination Survey. J Bone Metab 22:119-126.

MITHAL A, DINGRA V, LAU E. 2009. The Asian Audit - Epidemiology, Costs and Burden of Osteoporosis in Asia 2009. 126 D Nyon, Switzerland: International Osteoporosis Foundation 9-57.

MOSHFEGH AJ, RHODES DG, BAER DJ, MURAYI T, CLEMENS JC, RUMPLER WV, et al. 2008. The US Department of Agriculture Automated Multiple-Pass Method reduces bias in the collection of energy intakes. Am J Clin Nutr 88(2):324-32.

NICKLAS T, DR PH, LN. 2003. Calcium intake trends and health consequences from 440 childhood through adulthood, Journal of the American College of Nutrition Vol. 22 Issue 5 pg. 340-356 Published online on June 19, 2013

[NIH] National Institutes of Health – Osteoporosis and

Related Bone Diseases National Resource Center. 2015. Kids and their bones: a guide for parents. Retrieved from: http://www.niams.nih.gov/health_info/bone/bone_health/juvenile/default.asp. on September 2015.

RUTSTEIN SO, JOHNSON K. 2004. Demographic Health Survey Comparative Reports No. 6 - The Demographic Health Survey Wealth Index. Calverton, Maryland: ORC Macro 8-10p.

SAHI T. 1994. Genetics and epidemiology of adult-type hypolactasia. Scand J Gastroenterol Suppl 202:7–20.

SINGH GM, MICHA M, KHATIBZADEH S, SHI P, LIM S, ANDREWS KG, ENGELL RE, EZZATI M, MOZAFFARIAN D, GLOBAL BURDEN OF DISEASES NUTRITION AND CHRONIC DISEASES EXPERT GROUP (NUTRICODE). 2015. Global, regional, and national consumption of sugar-sweetened beverages, fruit juices, and milk: a systematic assessment of beverage intake in 187 countries. PLoS ONE 10(8): 1-20.

SPECKER BL. 2002. Determinants of bone mineral content in children. Annales Nestle 60:94-105.

STEVEN DE. (year). Calcium. Accessed April 2011. Available at: http://www.umm.edu/altmed/articles/calcium-000290.html. University of Maryland Medical Center, Baltimore, USA.

TANAKA K, MIYAKE Y, OKUBO H, HANIOKA T, SASAKI S, MIYATAKE N, ARAKAWA M. 2014. Calcium intake is associated with decreased prevalence of periodontal disease in young Japanese women. Nutrition Journal 13 (109): 1-6.

TEMPLE JL. 2009. Caffeine use in children: What we know, what we have left to learn, and why we should worry. Neurosci Biobehav Rev 33 (6): 793-806.

THEOBALD HE. 2005. Dietary calcium and health. Nutrition Bulletin 30: 237-277.

VARTANIAN LR, SCHWARTZ MB, BROWNELL KD. 2007. Effects of soft drink consumption on nutrition and health: a systematic review and meta-analysis. American Journal of Public Health 97 (4): 667-675.

VILLADOLID M, TANCHOCO C, DUANTE C, LIMBAGA ML, YEE G. 2002. The effect of calcium nutriture on the development of osteoporosis among Filipino adults. Philipp J Nutr Jul-Dec 49(3-4):6-16.