14 Calcium

14.1 Introduction

Calcium is the most abundant mineral in the body and makes up 1.9% of the body by weight. Nearly all (99%) of this is in the skeleton. The remainder is in the teeth (0.6%), the soft tissues (0.6%), the plasma (0.03%) and the extracellular fluid (0.06%). Calcium provides a "structural role" in providing rigidity (structure and strength) to the skeleton. This function is provided by a form of calcium phosphate that is generally known as hydroxyapatite [$Ca_{10}(OH)_2(PO4)_6$] crystals which are embedded in collagen fibrils (Nordin, 1997).

Calcium ions on the surface of bone can interact with ions in body fluids and act like a large ion exchanger. These properties are important in relation to the role of bone as a reserve of calcium to help maintain a constant concentration of blood calcium (Gurr, 1999). Blood calcium plays an important role to regulate vital body processes such as blood coagulation, muscle contraction, nerve transmission and mediation of some hormonal actions across cell membranes.

14.2 Food sources

Besides milk and dairy products, other calcium-rich foods in the Malaysian diet are fish with edible bones such as canned sardines and anchovies, beans and bean products including yellow dhal, tofu and *tempeh* (fermented soybeans), locally processed foods such as shrimp paste, *cincaluk* and *budu*, as well as vegetables like spinach, watercress, mustard leaves, *cekur manis*, tapioca leaves, *kai-lan* and broccoli (Tee *et al*., 1997). Currently, food manufacturers in Malaysia have also made available in the market calcium fortified products such as high-calcium milk, yogurt, breakfast cereals, biscuits and even rice.

According to IOM (1997), when evaluating the food sources of calcium, the calcium content is generally of greater importance than bioavailability. Calcium absorption efficiency is fairly similar from most foods, including milk and milk products and grains. Bioavailability of calcium from plant foods however can be affected by calcium chelators such as oxalate and phytate. Oxalic acids are found in high amounts in plant foods such as spinach, chocolate or cocoa products and in lesser quantities in dried beans, sweet potato, tea infusion, wheat germ, kale, okra and soybean products. However, a clinical study in humans has shown that calcium absorption from low-oxalate high calcium dark green vegetables from the kale is comparable to milk (Heaney & Weaver 1990). The authors concluded that the bioavailability from other *Brassica* family vegetables such as broccoli, mustard green, Chinese kale (*kai lan*) and cabbage can be considered as good as milk.

Phytate, the storage form of phosphorous in seeds, such as soybeans and pulses, is a modest inhibitor of calcium absorption. The phytic acid content of seeds depends on the phosphorous content of the soil of which the seeds are grown. Calcium absorption from low phytate soybeans have been shown to be similar with milk (Heaney, Weaver &

Fitzsimmons, 1991). The difference in absorption fraction from low and high phytate soybeans was reported to be 25%. This magnitude of difference may be important to individuals who consume soy products and no dairy foods as principle source of calcium. Other concentrated sources of phytate such as wheat bran or dried beans also substantially reduce calcium absorption.

Table 14.1 shows food sources of bioavailable calcium and their fractional absorption based on experiments carried out in Caucasians. Even though plant foods from the Brassica family such as broccoli, cabbage and kale have high fractional calcium absorption, milk still has the highest amount of absorbable calcium per serving compared to these foods. Thus, adding milk and milk products such as yogurt and cheese in an individual's diet makes meeting calcium requirements easier.

Table 14.1 Food sources of bioavailable calcium

Food	Serving size (g)	Calcium content (mg)	Fractional absorption (%)	Estimated absorbable calcium/serving (mg)	Servings needed to equal 1 glass of milk
Milk (or 1 glass yogurt or 1.5 oz cheddar cheese)	240	300	32.1	96.3	1.0
Beans, dried	177	50	15.6	7.8	12.3
Broccoli	71	35	61.3	21.5	4.5
Cabbage	85	79	52.7	41.6	2.3
Kale	65	47	58.8	27.6	3.5
Spinach	90	122	5.1	6.2	15.5
Tofu, calcium set	126	258	31.0	80	1.2

Source: Weaver & Heaney (1999)

14.3 Deficiencies

Inadequate intake, poor calcium absorption and excessive calcium losses contribute to reduced mineralization of bone. For example, in rickets and osteomalacia, vitamin D deficiency causes poor absorption of calcium and reduced mineralization of bone resulting in soft, pliable bones that deform easily. A reduction in absorbed calcium causes serum ionized calcium concentration to decline. This stimulates the parathyroid hormone (PTH) that will act in one of three ways to increase and maintain the level of serum calcium. The parathyroid hormone can increase the production of calcitriol (1,25-dihydroxycholecalciferol), which in turn increases calcium absorption through active transport in the gut and tubular reabsorption in the kidneys. Bone resorption may also increase leading to more calcium being released from the bone. Thus, PTH maintains normal circulating calcium concentration during calcium deprivation. It is noted nonetheless, this is done at the expense of skeletal mass.

Low levels of free ionized calcium in the blood (hypocalcaemia) can also result in tetany, which is manifested by intermittent muscle contractions, muscle pain, spasms and numbness in the hands and feet. There is also evidence that implicates low plasma calcium with chronic diseases such as hypertension and colon cancer (IOM, 1997).

Chronic calcium deficiency due to inadequate intake or poor intestinal absorption is one of the causes of reduced bone mass and osteoporosis. Osteoporosis is defined as a skeletal disease characterized by reduced bone mass, increased bone fragility and susceptibility to fracture (WHO, 1994). The clinical and public health impact of osteoporosis stems from its association with fractures of the hip, spine and forearm.

Cooper, Campion & Melton (1992) projected that 50% of all hip fractures in the world will occur in Asia in view of its rapid economic development and rising percentage of the elderly population. The Asian Osteoporosis Study (AOS) (Lau et al., 2001), which is the first multicenter study to compare hip fracture incidence in four Asian countries (Hong Kong, Singapore, Thailand & Malaysia), reported hip fracture rates for men:women (per 100,000) as follows: Hong Kong 180:459, Singapore 164:442, Malaysia 88:218, Thailand 114:289, compared to US 187:535 among White subjects. The study concluded that the rates of hip fractures were higher in more urbanized countries.

There is a dearth of information on the incidence of hip fractures in Malaysia. The Kuala Lumpur Hospital (HKL) had reported the incidence of hip fractures in 1981 as 0.49 per 1,000 and the rate increased to 0.70 per 1,000 in 1989 (Lee, Sidhu & Pan, 1993). In that report, the investigators also reported ethnic differences in admissions for hip fractures in HKL, in that Chinese accounted for 58% followed by Indians (27%) and Malays (15%). In 2001, hip fracture incidence from hospital records was reported to be the highest among Chinese (men 94/100,000, women 220/100,000) followed by Indians (men 98/100,000, women 204/100,000) and Malays (men 27/100,000, women 43 /100 000) (Lau et al., 2001).

14.4 Factors affecting calcium requirement

Bioavailability from the diet and absorptive efficiency

Calcium bioavailability from foods is of importance when dietary calcium intake is low and when Ca absorptive capacity declines, for example in aging. Low calcium absorption is associated with increased risk of hip fractures in women with low Ca intake (Ensrud et al., 2000). Several factors such as calcium intake, age, estrogen status, vitamin D status, and the intestinal transit time account for part of the individual variability of Ca absorptive capacity. Nonetheless, a large part of the variability remains unexplained. Dietary components that play a role in inhibiting calcium absorption include phytic acid from cereals and pulses, and oxalic acid from some varieties of vegetables. In contrast, dietary components that enhance calcium absorption include lactose and non-digestible polysaccharides (van den Heuval et al., 1999).

Dietary phosphorus

Phosphorus is a major structural component of bone in the form of calcium phosphate or hydroxyapatite. The regulation of blood calcium and phosphorus levels is interrelated through the actions of parathyroid hormone (PTH) and vitamin D. A decrease in the blood calcium levels, such as in the case of inadequate calcium intake, leads to a response by calcium-sensing proteins in the parathyroid glands, which secrete PTH. PTH in turn stimulates increased conversion of vitamin D to its biologically active form (calcitriol) in the kidneys. Calcitriol activates the vitamin D-dependent transport system in the small intestine, increasing the absorption of both dietary calcium and phosphorus. Although PTH stimulation results in decreased urinary excretion of calcium, it results in increased urinary excretion of phosphorus. Increased urinary excretion of phosphorus is beneficial because it helps to bring blood calcium levels up to normal, and also because high blood levels of phosphorus suppress the conversion of vitamin D to its active form in the kidneys.

Concerns for phosphorus intake have arisen due to presence of phosphoric acid in soft drinks and phosphate additives in a number of commercially prepared foods (Calvo & Park, 1996). Unlike calcium, phosphorus absorption is not as tightly regulated by the body. Hence, high dietary intake phosphorus gives rise to high blood phosphate levels which in turn, reduce the formation of calcitriol in the kidneys, reduce blood calcium and lead to elevated levels of PTH that may be detrimental on bone mineral content. Abnormally low Ca:P ratio (1:6) has been shown to cause bone loss in animal studies, and there have been reports of excessive fracture rates and low bone density in children with a history of high intake of phosphate-containing coal beverages (Weaver and Heaney, 1999). The concern is also for drinking of soft drinks displacing calcium-containing beverages including milk.

Sodium, protein and caffeine interactions

Sodium intake is an important determinant of calcium excretion because sodium competes with calcium reabsorption in the renal tubules as they share the same transport system in the proximal tubules. (Nordin, 1997). High sodium chloride intake results in increased absorbed sodium, increased urinary soldium and an increased obligatory loss of urinary calcium. Although indirect evidence indicates that dietary sodium chloride has a negative effect on the skeleton, the effect of a change in sodium intake on bone loss and fracture rates has not been reported. Thus, IOM (1997) felt that available evidence does not warrant different calcium intake requirements for individuals according to their salt consumption.

Animal protein has the same effect as sodium as its acid component is able to reduce tubular reabsorption of calcium. It is also likely that animal protein yields sulphate and phosphate residues which tie up calcium as complexes in the renal tubules (Nordin, 1997). It is estimated that for every gram of protein metabolized, urinary excretion of calcium increases by 50% or 0.025 mmol calcium taken out. Nevertheless, while protein intake appear to increase urinary calcium excretion, the effect of protein on calcium retention is controversial. IOM (1997) also pointed out that inadequate protein intakes (34 g/day) have been associated with poor general health and poor recovery from osteoporotic hip fractures. It was thus felt that available evidence does not warrant adjusting calcium intake recommendations based on dietary protein intake.

Caffeine intake in large amounts acutely increases urinary calcium losses in adults and postmenopausal women. While moderate consumption of coffee (1-2 cups a day) had little effect on calcium balance, caffeine may cause a small decrease in calcium absorption. The addition of milk into coffee could ameliorate the adverse effect of caffeine. Available evidence does not warrant different calcium intake recommendations for people with different caffeine intakes.

Ethnicity

In terms of calcium metabolism, fractional calcium absorption was reported to be much higher in Chinese women compared to the Whites. This has led to a suggestion that calcium requirements may be lower in Asians than for the Whites for the equivalent of calcium to be absorbed. Whether this represents an ethnic difference or just adaptation to chronically low dietary calcium intakes since childhood in the Chinese is not known (Kung et al., 1998).

14.5 Setting requirements and recommended intakes of calcium

Calcium requirements are best derived from balance studies, which is a careful measurement of calcium absorbed and calcium losses across a range of calcium intakes. The intake which provides just enough absorbed calcium to meet losses (zero balance) is then derived and set as the mean calcium requirement of an adult. In children, adolescence and pregnancy, the factorial approach is used to estimate calcium requirement because these groups need to be in positive calcium balance.

The factorial method is approached by estimating losses as increased by growth (if applicable) and then correcting for an expected rate of absorption in the diet. The calculation of "obligatory losses" often still depends on calcium balance studies. Nevertheless, the factorial approach is commonly used especially in population groups in which calcium balance studies are not conducted (FAO/WHO, 2002).

The main references used by the Technical Sub-Committee (TSC) on Minerals in arriving at recommended intakes for calcium for Malaysians were the FAO/WHO consultation reported published in 2002 and the IOM (1997) DRI recommendations. There are no known local studies on calcium requirements of communities but the TSC refered to several local studies on calcium intake of communities and a calcium supplementation study conducted recently. Several reports of studies conducted among Asian populations, especially Chinese were also useful references.

The TSC on Minerals had recommended the adoption of the FAO/WHO (2002) values as the revised RNI for Malaysia for most age groups. Modifications were made to specific age groups, as felt appropriate by the TSC. The RNIs for calcium are given in bold in the following paragraphs according to age groups and summarised in Appendix 14.1.

Infants (0-5 months)

The daily increment of calcium in the skeleton in the first 2 years of life is about 100 mg/day. The urinary calcium loss is about 10 mg/day. Therefore, infants need to absorb about 120 mg of calcium per day for normal growth. Absorption of calcium is 55-60% from human breast milk, while that from infant formula is lower at 40%. It is estimated therefore infants need to have an intake of about 240 mg/day in order to meet the required amount of absorbed calcium of 120 mg. Based on an average daily intake of 750 ml breast milk and an average content of 264 mg calcium per litre of breast milk, the proposed RNI for infants (0-5 months) who are exclusively breastfed is set at 300 mg calcium/day (EAR +2SD). Similarly, for formula-fed babies, the recommended amount is set higher at 400 mg calcium/day. Similar approaches were taken by IOM (1997) and the FAO/WHO Consultation (2002).

RNI for infants

0 – 5 months	**breast fed**	**300 mg/day**
	formula fed	**400 mg/day**

Infants (6-11 months)

As intake of solid foods increases for infants aged 6-11 months, calcium intake from breast milk decreases. There is also lower calcium concentration of breast milk at 7-12 months of lactation. Hence, calcium requirement for this age group is expected to be derived increasingly from solid foods. Taking into account the lower calcium absorption from solid foods and formula milk as compared to breast milk, FAO/WHO (2002) had proposed the RNI for infants 6-11 months to be 400 mg calcium/day.

RNI for infants

6 – 11 months	**400 mg/day**

Children

The amount of calcium that is accumulated in young children, mainly for bone growth, increases from 120 mg at age 2 to 400 mg at age 9. Hence, the daily accretion rate is estimated to be 120 mg. The urinary calcium loss is estimated at 60 mg/day and dermal loss 40 mg/day. These losses together with the accretion rate yield 220 mg/day that must be absorbed. Thus, the FAO/WHO (2002) RNI for children aged 1-9 years is 500 to 700 mg/day – the lower value for younger children and the higher value for the older children.

The study of Lee, Leung & Lui (1993) amongst Hong Kong children showed that those with habitually higher calcium intakes during the first 5 years of life had significantly higher bone mineral content than in children with lower calcium intakes of less than 400 mg/day. Lee & Leung (1995) also showed that amongst 7-year old Hong Kong Chinese children who habitually consume a low calcium diet (280 mg/day), gains in radial bone density (3.1 % more than controls) were seen when supplemented with 300 mg/day calcium carbonate for 18 months.

RNI for children

1 - 3 years	**500 mg/day**
4 - 6 years	**600 mg/day**
7 - 9 years	**700 mg/day**

Adolescents

There is a vast increase in the rate of skeletal calcium accretion at puberty – from age 10 to 17 years. This is the period of growth spurts and the attainment of 'peak bone mass'. Achieving a higher peak bone mass is considered a better approach for prevention of osteoporosis. Several studies have shown that calcium supplementation of adolescents of 500-1000 mg/day led to increased bone mineral accretion, which can be sustained for at least 3.5 years (Cadagon *et al.,* 1997, Bonjour *et al.,* 2001).

The peak rate of calcium accumulation is 300-400 mg daily, which occurs earlier in girls but continues longer in boys. Thus, it is difficult to justify any difference between recommended allowances for boys and girls. Assuming a target value of 300 mg per day for the skeleton, urinary loss of 100 mg/day and losses in the dermal and feces of 40 mg/day, a total amount of 440 mg calcium needs to be absorbed per day. Assuming a high calcium absorption of 35% in a mixed diet (higher than adults), FAO/WHO (2002) has recommended 1300 mg/day and 1000 mg/day for populations whose animal protein intake is 60-80 g/day and 20-40 g/day respectively. Assuming Malaysian animal protein intake is closer to the latter level, the proposed RNI for calcium for Malaysian adolescents aged 10-18 years is set at 1000 mg/day.

RNI for adolescents

Boys	**10 – 18 years**	**1,000 mg/day**
Girls	**10 – 18 years**	**1,000 mg/day**

Adults (ages 19 to 50 years in women & 19 to 65 years in men)

After peak bone mass attainment, bone formation and resorption is balanced during adulthood. Among Asians, calcium balance is achieved at intakes of 340-540 mg/day (Chinese Nutrition Society, 2000). Bone mass density is relatively stable between ages 20-50, and hence there are relatively few intervention studies on the role of calcium during young and middle adulthood. Two intervention studies showed that 1000 mg of calcium supplement was able to slow down bone loss by about 1% in premenopausal women. The results of two meta-analysis found significant positive effect of calcium intake and bone maintenance (Welten *et al*., 1995; Andersen & Rondano, 1996). A study amongst young Chinese women concluded that an intake above 600 mg/day would have beneficial effect on bone mass (Ho *et al*., 1994). FAO/WHO (2002) has recommended 750 mg/day for populations with animal protein intake of 20-40 g/day. Studies conducted in Thailand and China has led to their recommendation of 800 mg/day (Chinese Nutrition Society, 2000). Based on these considerations, the proposed RNI for calcium for adults aged 19 to 50 years in women and men is set at 800 mg/day.

RNI for adults

Men	**19 - 65 years**	**800 mg/day**
Women	**19 - 50 years**	**800 mg/day**

Older adults (women aged above 51 years; men aged above 65 years)

Women generally attain menopause at approximately 50 years of age. The combined effects of aging and menopause lead to a 20-25% decrease in absorption efficiency for calcium. Menopause is also associated with a rise in excretion of obligatory calcium or fasting urine of about 20 mg–40-mg daily. All these factors are taken into consideration in recommending a higher amount of calcium intake for menopausal adults. There is no evidence of differences between recommendations for men and women (IOM, 1997). In fact, after the age of 65, men are also at risk of age-related osteoporosis. There is also not enough evidence to support different recommendations based on menopausal status or use of HRT.

In a study by Dawson-Hughes *et al*. (1990), it was shown that in subjects taking less than 400 mg calcium per day, increasing their calcium intake to 800 mg/day reduced bone loss significantly. Supplementation of Malaysian postmenopausal women with 1200 mg calcium per day using milk has been shown to reduce rate of bone loss (Chee *et al*., 2003). Similarly, results from several reviews and meta-analysis of randomized-controlled trials indicate that calcium supplementations of up to 500-1000 mg/day reduced age-related bone loss in peri and postmenopausal women (Nordin, 1997; Shea *et al*., 2004). Calcium supplementation is reported to be able to reduce fracture risk by about 24 to 30% in postmenopausal women taking 1000 mg/day (Ilich & Kerstetter 2000).

Available balance data indicate that the requirement of women aged over 50 is at least 1000 mg/day (IOM, 1997). Therefore, the recommendation for calcium is set at 1000 mg/day for women aged 50 years and above and men aged 65 years and above.

RNI for older adults

Men	**> 65 years**	**1,000 mg/day**
Women	**> 51 years**	**1,000 mg/day**

Pregnancy

Calcium absorption increases during pregnancy, and there is emerging evidence that the calcium required for foetal bone mineralization can be obtained with no detectable mobilization of maternal bone. Thus, according to IOM (1997) no increment in calcium RDA is warranted for pregnancy. However, in countries such as Malaysia in which habitual calcium intake is low, a high calcium intake may benefit the foetus. The recommendation for calcium during pregnancy is set at 1000 mg/day.

RNI for pregnancy

1st trimester	**1,000 mg/day**
2nd trimester	**1,000 mg/day**
3rd trimester	**1,000 mg/day**

Lactation

The loss of calcium from maternal skeleton that occurs during lactation is not prevented by increased dietary calcium, and the calcium lost appears to be regained following weaning. There is no evidence that calcium intake in lactating women should be increased above that of nonlactating women and no additional amount was provided (IOM, 1997). The FAO/WHO Consultation (2002) also did not recommend any extra calcium allowance during lactation. The calcium RNI for lactating women is set at 1000 mg/day, which is consistent with the recommendation of FAO/WHO (2002).

RNI for

Lactation	**1,000 mg/day**

Discussions on revised RNI for Malaysia

The previous recommended dietary intakes for calcium (Teoh, 1975) were lower than the current recommended calcium intake (2005) for Malaysian children, adolescents and adults but higher for infants, pregnant and lactating mothers. The calcium intake recommendations by FAO/WHO (2002) are similar to the recommended values by IOM (1997) for almost all age groups. For infant and children age groups, the Malaysian RNI adopted similar values as FAO/WHO (2002). However, for adolescents and adults, assuming a lower animal protein intake (20-40 g/day) in Malaysia, the recommended calcium intakes are lower than the values indicated by FAO/WHO (2002) for similar age groups (Appendix 14.1). FAO/WHO (2002) recommended higher calcium intakes for adolescents and adults based on populations whose animal protein intake is 60-80 g/day.

14.6 Toxicity and tolerable upper intake levels

Calcium levels in the body are very closely controlled so that excessive accumulation in blood or tissues arising from over consumption is unknown. Abnormally high calcium concentrations may occur but usually secondary to diseases such as bone cancer, hyperthyroidism and hyperparathyroidism. The efficiency of calcium absorption decreases with intake, thereby providing the body with a protective mechanism to lessen the chances of calcium intoxication. Currently, the available data on the adverse effects of excessive calcium intake in humans primarily concerns overuse of calcium supplements (National Institute of Health, 1994).

The common effects of excessive calcium intakes are kidney stones (nephrolithiasis), milk-alkali syndrome and interaction of calcium with absorption of other essential minerals such as iron, zinc, magnesium and phosphorous. IOM (1997) had established a tolerable upper level (UL) of 2,500 mg per day for all age groups.

With regards to phosphorus implications, the most serious adverse of abnormally elevated blood levels of phosphate (hyperphosphatemia) is the calcification of non-skeletal tissues most commonly the kidneys. Such calcium phosphate deposition can lead to organ damage. Hyperphosphatemia from dietary cause is a problem mainly in people with kidney failure, since the kidneys are normally efficient at eliminating excess phosphate from the circulation. In order to avoid hyperphosphatemia, IOM set a UL for oral phosphorus intake of 4g/day for young adults and 3g/day for older adults.

14.7 Research recommendations

The following priority areas of research are recommended:

- Nationally representative data on calcium intakes of various population groups such as children, adolescents, adults and elderly.

- Content of calcium in local foods and absorption efficiency, especially from non-dairy foods.
- Studies on the effects of increased calcium intakes on skeletal mass and bone loss. In adolescents, it is important to determine to what extent increased calcium intake can influence peak bone mass formation in conjunction with other nutrients and physical activity level. Identify calcium thresholds above which further calcium intake would be ineffective.
- Calcium balance studies on various age and ethnic groups to determine optimal recommendations of calcium intake.
- Effects of consumption of soft drinks and other processed foods high in phosphorus on blood phosphorus and bone health among various groups, especially children and young adults

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Appendix 14.1 Comparison of recommended intake for calcium: RDI Malaysia (1975), RNI Malaysia (2005), RNI of FAO/WHO (2002) and AI of IOM (1997)

Malaysia (1975)		Malaysia (2005)		FAO/WHO (2002)		IOM (1997)	
Age groups	**RDI (mg/day)**	**Age groups**	**RNI (mg/day)**	**Age groups**	**RNI (mg/day)**	**Age groups**	**AI (mg/day)**
Infants		Infants		Infants		Infants	
< 1year	550	0 – 5 months	300 (bf) 400 (ff)	0 – 6 months	300 (bf) 400 (ff)	0 – 6 months	210
		6 – 11 months	400	7 – 11 months	400	7 – 12 months	270
Children		Children		Children		Children	
1 – 3 years	450	1 – 3 years	500	1 – 3 years	500	1 – 3 years	500
4 – 6 years	450	4 – 6 years	600	4 – 6 years	600	4 – 8 years	800
7 – 9 years	450	7 – 9 years	700	7 – 9 years	700		
Boys		Boys		Boys		Boys	
10 – 12 years	650	10 – 18 years	1,000	10 – 18 years	1,300	9 – 13 years	1,300
13 – 15 years	650					14 – 18 years	1,300
16 – 19 years	500						
Girls		Girls		Girls		Girls	
10 – 12 years	650	10 – 18 years	1,000	10 – 18 years	1,300	9 – 13 years	1,300
13 – 15 years	650					14 – 18 years	1,300
16 – 19 years	500						
Men		Men		Men		Men	
20 – 39 years	450	19 – 65 years	800	19 – 65 years	1,000	19 – 30 years	1,000
40 – 49 years	450	> 65 years	1,000	> 65 years	1,300	31 – 50 years	1,000
50 – 59 years	450					51 – 70 years	1,200
≥60 years	450					>70 years	1,200
Women		Women		Women		Women	
20 – 39 years	450	19 – 50 years	800	19 – 50 years	1,000	19 – 30 years	1,000
40 – 49 years	450	51 – 65 years	1,000	51 – 65 years	1,300	31 – 50 years	1,000
50 – 59 years	450	> 65 years	1,000	> 65 years	1,300	51 – 70 years	1,200
≥60 years	450					>70 years	1,200
Pregnancy		Pregnancy		Pregnancy		Pregnancy	
1st trimester	450	1st trimester	1,000	1st trimester	1,000	14 – 18 years	1,300
2nd trimester	1,200	2nd trimester	1,000	2nd trimester	1,000	19 – 30 years	1,000
3rd trimester	1,200	3rd trimester	1,000	3rd trimester	1,200	31 – 50 years	1,000
Lactation		Lactation		Lactation		Lactation	
1st 6 months	1,200	0 – 3 months	1,000	0 – 3 months	1,000	14 – 18 years	1,300
2nd 6 months	450	4 – 6 months	1,000	4 – 6 months	1,000	19 – 30 years	1,000
		7 – 12 months	1,000	7 – 12 months	1,000	31 – 50 years	1,000

bf=breast fed
ff=formula fed