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Bone Health in Children and Adolescents: Implications for Client Counseling

2011 Edition

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See *Information About This Course* on page 2

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Suggested CDR Learning Codes: 2090, 3000, 3020, 4000, 4040, 4150, 4160, 6000
Level 2

Learning Objectives

Upon completion of this module the student will be able to:

1. Describe evidence linking diet and physical activity to bone health in children and adolescents.
2. Describe how fracture incidence in children and adolescents has changed over the last generation, and identify at least two possible explanations for this change.
3. Identify lifestyle and dietary factors that are related to suboptimal bone health.
4. Identify at least one way to better assess calcium intake and weight bearing activity with clients.
5. Identify at least two strategies to help clients increase their calcium consumption if needed.
6. Describe one non-dietary way children and adolescents can optimize their bone health to prevent fractures.

Information About This Course

The slide portion of this course will take about 30 minutes to complete and will cover the background research on bone health in children and adolescence, dietary factors involved in bone health, calcium recommendations versus actual intakes in the US, and non-dietary factors involved in bone health. The slides include practical suggestions for assessing calcium intake and physical activity and tips on how to encourage clients to change their lifestyle to improve their bone health.

Written course materials to supplement the slide presentation are also included. There is also a bibliography available for those seeking additional information on the topic, handouts to use in your practice and a list of resources for client counseling.

Table of Contents

- Listen to the **Slide Presentation** at the following URL address:
http://www.dairycouncilofca.org/HealthProfessionals/BoneHealthCourse/BH_online.aspx
- Read the following monographs contained in this PDF download:
 - **Dietary Reference Intakes for Calcium and Vitamin D**
 - **Optimizing Bone Health in Children and Adolescents: Implications for Current and Future Health**
 - **Vitamin D: A New Look at an Old Vitamin**
- Review the attached client handouts to consider using in your practice:
 - **Vitamin D: What You Need to Know About the “Sunshine” Vitamin**
 - **Eat Well, Be Active!**
 - **5 Easy Steps to Stronger Bones... Go For it!**
- Practice using the **Bone Health Assessment** tool yourself or with a colleague
- Explore the **Health Professional Resources, Client Education Resources and Bibliography**
- Take examination to receive **Continuing Education Credit**. (See the following page regarding Continuing Education Credit.)

Continuing Education Credit



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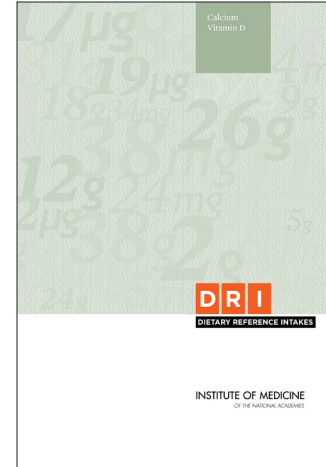
Introduction

This presentation describes an internet-based instructional course developed to assist the health professional identify and assess factors that affect their clients' bone health. This topic has received a surge of interest lately as fracture incidence in children and adolescents has increased by one-third in boys and more than one-half in girls, as compared to a generation ago. The increase in fracture incidence is attributed to replacement of milk with other beverages, decreased physical activity levels and higher incidence of overweight and obesity.

Dietary and non-dietary factors involved in bone health are reviewed in this course, with calcium given special attention as the primary nutrient involved in bone health. Calcium recommendations are compared to actual intakes across the lifespan and suggestions provided for improvement. Methods to assess calcium status are outlined, barriers to adequate consumption identified, and counseling strategies provided.

Three renowned experts in bone health research and public health offer their insights throughout the course. The health professional undertaking the course is directed toward additional reading material, resources and assessment tools to further enhance their understanding of the importance of optimizing bone health at an early age and to arm them with necessary and applicable tools to put this knowledge into action. As our population ages, it will be critical to proactively address not just early implications of bone health such as fracture risk, but future implications such as osteoporosis and osteopenia, as a lifelong effort to prevent these diseases.

Dietary Reference Intakes for Calcium and Vitamin D



Calcium and vitamin D are two essential nutrients long known for their role in bone health. Over the last ten years, the public has heard conflicting messages about other benefits of these nutrients—especially vitamin D—and also about how much calcium and vitamin D they need to be healthy.

To help clarify this issue, the U. S. and Canadian governments asked the Institute of Medicine (IOM) to assess the current data on health outcomes associated with calcium and vitamin D. The IOM tasked a committee of experts with reviewing the evidence, as well as updating the nutrient reference values, known as Dietary Reference Intakes (DRIs). These values are used widely by government agencies, for example, in setting standards for school meals or specifying the nutrition label on foods. Over time, they have come to be used by health professionals to counsel individuals about dietary intake.

The committee provided an exhaustive review of studies on potential health outcomes and found that the evidence supported a role for these nutrients in bone health but not in other health conditions. Further, there is emerging evidence that too much of these nutrients may be harmful.

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Health Effects of Vitamin D and Calcium Intake

The new reference values are based on much more information and higher-quality studies than were available when the values for these nutrients were first set in 1997. The committee assessed more than one thousand studies and reports and listened to testimony from scientists and stakeholders before making its conclusions. It reviewed a range of health outcomes, including but not limited to cancer, cardiovascular disease and hypertension, diabetes

and metabolic syndrome, falls, immune response, neuropsychological functioning, physical performance, preeclampsia, and reproductive outcomes. This thorough review found that information about the health benefits beyond bone health—benefits often reported in the media—were from studies that provided often mixed and inconclusive results and could not be considered reliable. However, a strong body of evidence from rigorous testing substantiates the importance of vitamin D and calcium in promoting bone growth and maintenance.

Dietary Reference Intakes

The DRIs are intended to serve as a guide for good

nutrition and provide the basis for the development of nutrient guidelines in both the United States and Canada. The science indicates that on average 500 milligrams of calcium per day meets the requirements of children ages 1 through 3, and on average 800 milligrams daily is appropriate for those ages 4 through 8 (see table for the Recommended Dietary Allowance—a value that meets the needs of most people). Adolescents need higher levels to support bone growth: 1,300 milligrams per day meets the needs of practically all adolescents. Women ages 19 through 50 and men up to 71 require on average 800 milligrams daily. Women over 50 and both men and women 71 and older should take in 1,000 milligrams per day on average to ensure they are meeting their daily

TABLE: Dietary Reference Intakes for Calcium and Vitamin D

Life Stage Group	Calcium			Vitamin D		
	Estimated Average Requirement (mg/day)	Recommended Dietary Allowance (mg/day)	Upper Level Intake (mg/day)	Estimated Average Requirement (IU/day)	Recommended Dietary Allowance (IU/day)	Upper Level Intake (IU/day)
Infants 0 to 6 months	*	*	1,000	**	**	1,000
Infants 6 to 12 months	*	*	1,500	**	**	1,500
1-3 years old	500	700	2,500	400	600	2,500
4-8 years old	800	1,000	2,500	400	600	3,000
9-13 years old	1,100	1,300	3,000	400	600	4,000
14-18 years old	1,100	1,300	3,000	400	600	4,000
19-30 years old	800	1,000	2,500	400	600	4,000
31-50 years old	800	1,000	2,500	400	600	4,000
51-70 year old males	800	1,000	2,000	400	600	4,000
51-70 year old females	1,000	1,200	2,000	400	600	4,000
>70 years old	1,000	1,200	2,000	400	800	4,000
14-18 years old, pregnant/lactating	1,100	1,300	3,000	400	600	4,000
19-50 years old, pregnant/lactating	800	1,000	2,500	400	600	4,000

*For infants, Adequate Intake is 200 mg/day for 0 to 6 months of age and 260 mg/day for 6 to 12 months of age.

**For infants, Adequate Intake is 400 IU/day for 0 to 6 months of age and 400 IU/day for 6 to 12 months of age.

Higher levels of both nutrients have not been shown to confer greater benefits, and in fact, they have been linked to other health problems, challenging the concept that “more is better.”

needs for strong, healthy bones.

Determining intake levels for vitamin D is somewhat more complicated. Vitamin D levels in the body may come from not only vitamin D in the diet but also from synthesis in the skin through sunlight exposure. The amount of sun exposure one receives varies greatly from person to person, and people are advised against sun exposure to reduce the risk of skin cancer. Therefore, the committee assumed minimal sun exposure when establishing the DRIs for vitamin D, and it determined that North Americans need on average 400 International Units (IUs) of vitamin D per day (see table for the Recommended Dietary Allowances—values sufficient to meet the needs of virtually all persons). People age 71 and older may require as much as 800 IUs per day because of potential changes in people’s bodies as they age.

Questions About Current Intake

National surveys in both the United States and Canada indicate that calcium may remain a nutrient of concern, especially for girls ages 9–18. Some postmenopausal women taking supplements may be getting too much calcium, thereby increasing their risk for kidney stones.

Information from national surveys shows vitamin D presents a complicated picture. While the average total intake of vitamin D is below the median requirement, national surveys show that average blood levels of vitamin D are above the 20 nanograms per milliliter that the IOM committee found to be the level that is needed for good bone

health for practically all individuals. These seemingly inconsistent data suggest that sun exposure currently contributes meaningful amounts of vitamin D to North Americans and indicates that a majority of the population is meeting its needs for vitamin D. Nonetheless, some subgroups—particularly those who are older and living in institutions or who have dark skin pigmentation—may be at increased risk for getting too little vitamin D.

Before a few years ago, tests for vitamin D were conducted infrequently. In recent years, these tests have become more widely used, and confusion has grown among the public about how much vitamin D is necessary. Further, the measurements, or cut-points, of sufficiency and deficiency used by laboratories to report results have not been set based on rigorous scientific studies, and no central authority has determined which cut-points to use. A single individual might be deemed deficient or sufficient, depending on the laboratory where the blood is tested. The number of people with vitamin D deficiency in North America may be overestimated because many laboratories appear to be using cut-points that are much higher than the committee suggests is appropriate.

Tolerable Upper Levels of Intake

The upper level intakes set by the committee for both calcium and vitamin D represent the safe boundary at the high end of the scale and should not be misunderstood as amounts people need or should strive to consume. While these values



Committee to Review Dietary Reference Intakes for Vitamin D and Calcium

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vary somewhat by age, as shown in the table, the committee concludes that once intakes of vitamin D surpass 4,000 IUs per day, the risk for harm begins to increase. Once intakes surpass 2,000 milligrams per day for calcium, the risk for harm also increases.

As North Americans take more supplements and eat more of foods that have been fortified with vitamin D and calcium, it becomes more likely that people consume high amounts of these nutrients. Kidney stones have been associated with taking too much calcium from dietary supplements. Very high levels of vitamin D (above 10,000 IUs per day) are known to cause kidney and tissue damage. Strong evidence about possible risks for daily vitamin D at lower levels of intake is limited, but some preliminary studies offer tentative signals about adverse health effects.

Conclusion

Scientific evidence indicates that calcium and vitamin D play key roles in bone health. The current evidence, however, does not support other benefits for vitamin D or calcium intake. More targeted research should continue. Higher levels have not been shown to confer greater benefits, and in fact, they have been linked to other health problems, challenging the concept that “more is better.” 

Study Sponsors

Agricultural Research Service, U.S. Department of Agriculture
Center for Nutrition Policy and Promotion, U.S. Department of
Agriculture

Department of the Army, U.S. Department of Defense

Food and Drug Administration, U.S. Department of Health and
Human Services

Health Canada

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Optimizing Bone Health in Children and Adolescents: Implications for Current and Future Health

Background

Although bone health has always been an issue for our population of children and adolescents, over the past decade concern has been elevated to unprecedented levels.¹ With life expectancy on the rise in the United States, osteopenia and osteoporosis have become increasing health concerns among the older population. Both of these terms refer to lower-than-normal bone mineral density, which can result in debilitating bone fractures and falls as one ages. Optimizing bone health in childhood and adolescence results in stronger, denser bones in adulthood and reduces the chance of developing these diseases later in life.

There are consequences of lower bone mineral density realized early in life as well. Children and adolescents today are more likely to break a bone than their parents were. Studies from the United States, Sweden and Japan have shown that fracture incidences have risen steadily in the past four decades. Age-adjusted incidence rates in the United States are 32 percent higher in boys and 56 percent higher in girls in the time span between 1969-1971 and 1991-2001.² There are many hypotheses for this increase in fracture risk. Experts believe that reduced dairy consumption and thus lower calcium and vitamin D intakes—important nutrients in optimizing bone mass deposition—may play a role in the escalating fracture incidence. Lower levels of physical activity—particularly weight-bearing types—among our young population and higher incidence of overweight and obesity have also been linked to greater fracture risk.

Thus, it is more important than ever to ensure that children and adolescents optimize their peak bone mass (PBM) to avoid fractures early in life and to prevent or delay development of osteopenia and osteoporosis later in life.

Calcium intake is irrefutably linked to bone health

Bone health is influenced by many factors, including genetics, physical activity and nutrition. Calcium deserves special attention, as it is the largest component of bone minerals and is deficient in many diets. It is well-known that consuming an adequate intake of calcium during childhood and adolescence is critical for the development of PBM, which helps to reduce the risk of fractures and osteoporosis in later years. Because an adult cannot compensate for

inadequate PBM deposited in adolescence, prevention of osteoporosis starts in childhood. Optimizing calcium intake for bone health is particularly important during adolescence, as peak calcium-accretion rate occurs on average at 12.5 years in girls and 14.0 years in boys.³ In addition, during the 3- to 4-year period of rapid bone mass deposition during adolescence, 40 percent of total adult bone mass is accumulated.⁴

A multitude of studies has shown that increasing dairy or calcium intakes during childhood and adolescence enhances bone health at various skeletal sites,⁵ particularly in those populations with low calcium intakes.⁶ Because it is difficult to accurately assess dietary calcium, intervention studies are prioritized over observational studies. In a 3-year clinical trial of 22 pairs of twins, average age 7 years, the twin who consumed 1,600 milligrams of calcium a day deposited 3 to 5 percent more bone mass than his or her counterpart, whose intake was only 900 milligrams per day.⁷ A clinical trial in 8-year-old girls showed that increasing calcium intake from 900 to 1,750 milligrams per day for one year increased bone mineral density in the arms, hips and spine,⁸ with effects greatest in those with low baseline calcium intakes. Other clinical trials in pre-teens and teens have similarly found that increasing calcium intake, either from dairy food sources or from supplements, increases bone density.⁹⁻¹²

The source of calcium in optimizing bone health seems to be important. Various observational and epidemiological studies indicate that consuming milk and other dairy foods during childhood and adolescence is a primary determinant of bone health.¹³⁻¹⁷ Clinical studies whereby milk or other dairy products were added to subjects' diets also show increases in bone mineral density at various sites,¹⁸ as well as improved nutrient intakes.^{18,19} In addition, children who avoid milk are known to have suboptimal bone mass and are at higher risk of fractures.²⁰⁻²³ Goulding et al. found bone density to be 3 to 5 percent lower in girls aged 3 to 15 years who had forearm fractures, compared to those who had never broken a bone.²⁴ In another study, fracture incidence in children who avoid milk was 160 percent higher than expected from average fracture rates in the population.²²

Increasing calcium and/or dairy intakes in children and adolescents is well accepted as a means of increasing bone mineralization, at least over a short period of time. Whether these benefits persist after intervention has stopped, however, is not clear, with some studies indicating that the effects are maintained for up to 7-1/2 years²⁵⁻²⁷ and others finding no sustained effect.^{28,29} To ensure long-term benefits of optimal bone health, therefore, it is important to sustain adequate calcium intakes not just during the childhood and adolescent years but into adulthood as well.

Some research, on the other hand, does not confirm this relationship between calcium intake and bone health. Calcium supplementation trials do not always produce the expected results in bone mineral density to the extent needed to reduce risk of fractures,^{30,31} or gains may have been observed but not maintained over time.¹¹ There are various explanations for these discrepancies between studies. Subjects' baseline calcium intakes may be high enough that additional calcium, either in the form of diet or supplements, does not lend any additional benefit to bone health and/or fracture rates. Methods available for estimating habitual calcium intakes are not ideal and

invariably introduce some error. Assessing long-term calcium intakes can pose challenges as researchers are dependent upon children's or caregivers' memories of past calcium intakes. Still, the overwhelming preponderance of research supports a strong connection between calcium intake and bone health.

Bone health is associated with fracture risk

Although fracture incidence is significantly higher today than it was a generation ago, the reasons for this are not completely understood. Research suggests that risk factors may involve inadequate bone mass, early age of first fracture, adverse symptoms to and avoidance of cow's milk, low dietary calcium intakes, lack of physical activity and being overweight.³²

A recent meta-analysis in 10 case-control studies suggests an association between low bone density and fractures in children.³³ Observational data also show dietary calcium intake predicts fracture risk; high calcium intakes are associated with a protective effect against fractures in adolescent boys and girls,³⁴ and children with low calcium intakes have a fracture rate 2.7 times greater than birth-cohort controls.³⁵ A recent case-control study found that girls with a history of a milk-free diet due to allergy had a 4-1/2 times greater risk of fracture; this association was not observed in boys.³⁶ Another study found that of 50 children aged 3 to 13 years, those who avoided milk reported higher incidence of fractures and the majority of those fractures were associated with only slight trauma.²²

Research also shows that overweight children experience more fractures than normal-weight children,³⁷ and children who have a fracture at an early age have a higher rate of repeat fractures.³² A case-control study in boys aged 3 to 19 years found that high adiposity and low bone mineral content were associated with increased risk of forearm fractures.³⁸ Another study found that high body weight contributes to fracture risk in children and adolescents who fracture their forearms repeatedly.³² Body weight may contribute to fracture risk by placing extra burden on bones during falls. Lack of physical activity—common in overweight children—may also play a role in fracture risk, as physical activity is associated with stronger bones.

Calcium sources and equivalents to 1 cup of milk

Food	Serving Size	Calcium Content (mg/serving)	Amount needed to equal 1 cup of milk*
Milk	1 cup	290	1
Beans, Pinto	3 ounces	45	8.1
Bok Choy	1/2 cup	79	2.3
Broccoli	1/2 cup	35	4.5
Cheese, cheddar	1.5 ounces	303	1
Mustard greens	1/2 cup	212	1.1
Kale	1/2 cup	61	3.2
Orange juice, calcium-fortified	1 cup	300	0.88
Soy beverage, calcium-fortified	1 cup	300	1.3
Spinach	1/2 cup	115	16.3
Sweet potatoes	1/2 cup	44	9.8
Yogurt	1 cup	300	1
Tofu, calcium-set	1/2 cup	258	1.2

*Takes into account average calcium content of food listed and bioavailability. Adapted from reference 45.

Calcium intakes versus recommendations: Still a big gap

The majority of children and teens do not consume nearly enough dietary calcium on a daily basis. It is estimated that nine out of 10 girls and six out of 10 boys aged 12 to 19 years do not consume adequate calcium.³⁹

Children aged 9 to 19 years need 1,300 milligrams of calcium, the highest of any age group, to optimize the calcium deposited in their bones during this time of rapid growth. Various government agencies and health organizations encourage consumption of dairy products as the primary sources of dietary calcium. The 2010 Dietary Guidelines for Americans recognize the importance of dairy in the diet in meeting calcium needs and recommend that everyone 9 years and older consume 3 cups of low-fat dairy foods as part of a healthful diet.⁴⁰ Similarly, in the U.S. Surgeon General's Report on Bone Health and Osteoporosis,¹ three daily servings of low-fat milk are recommended to build and maintain strong bones. In its report on optimizing bone health and calcium intakes of infants, children and adolescents, the American Academy of Pediatrics recommends three 8-ounce glasses of milk a day, or the equivalent, for children 4 to 8 years of age, and four glasses for adolescents.⁴ Finally, the National Medical Association recommends that the American public—African Americans in particular—consume three to four servings of low-fat milk, cheese or yogurt a day to help reduce the risk of nutrient-related diseases such as osteoporosis.⁴¹

Unfortunately, American adolescents do not come close to these recommendations. Currently, it is estimated that teenage boys consume only about 2.4 servings of dairy per day, while teenage girls consume about 1.7 servings a day.⁴² Other foods—dark green, leafy vegetables such as kale and bok choy—are also dietary sources of calcium and can help to make up the difference, but it takes many more servings of these to get the same amount of calcium as that in 3 to 4 cups of milk (see Table).

Other nutrients involved in bone health

Other nutrients besides calcium are critical to bone health. Vitamin D, protein, phosphorus, magnesium, potassium, vitamin B12 and zinc are all needed in bone deposition. Consuming a well-balanced diet

composed of a variety of foods, including dairy products and other calcium-rich foods, fruits and vegetables, grains and meat or beans on a daily basis is the best way to ensure an adequate intake of all these important bone-building nutrients.

The role of the practicing health professional

Pediatricians and other health professionals who work with children and adolescents are in an ideal position to monitor and assess calcium status, identifying marginal or deficient intakes that can lead to fractures and future issues with osteopenia and osteoporosis. In evaluating current and future bone health in young clients, consider the following:

- Experts agree that it is best to consume adequate calcium from nutrient-rich food sources rather than supplements whenever possible. Children need two to three servings of dairy a day to meet their needs for optimal bone health; adolescents need three to four servings. A serving is equivalent to 1 cup of milk or yogurt and 1-1/2 ounces of cheese. All milks, regardless of fat level or added flavorings, contain about 300 milligrams of calcium per cup.
- Calcium intake should be assessed at least three times during childhood and adolescence during routine check-ups: at 2 or 3 years of age, during preadolescence (8 to 9 years), and during early adolescence.⁴ Education materials geared for these specific ages can facilitate client education.
- Because dairy foods account for 72 percent of the calcium in the United States food supply,⁴³ query parents and caregivers of young children as to their usual intake of dairy products. Adolescents and teens can be asked directly about their habitual diets. Remember that dairy foods contain a “package” of bone-building nutrients such as vitamin D, magnesium, phosphorus and protein.
- Offering cheese and yogurt at snack time is an ideal way to consume extra dairy servings, and generally appeal to even the most selective of children and adolescents. Other calcium-rich foods, such as beans, nuts and dark green, leafy vegetables, can round out daily calcium intake needed for optimal bone health.

- In situations in which it is not possible for children and adolescents to consume the needed levels of dairy foods, products fortified with calcium are another option. Juices, breakfast cereals, bars and other calcium-fortified foods are plentiful on the market shelves. If these are consumed in place of dairy foods, however, ensure that vitamin D intake is also adequate.
- Assess physical-activity levels in children and adolescents as well, emphasizing weight-bearing activities like running, jumping or walking that enhance bone health.
- To identify children with bone mass deficits and to monitor changes in bones due to chronic disease or therapies, clients' bone mineral density and content can be checked against age-, race- and sex-specific reference curves.⁴⁴
- Follow up at each visit to re-evaluate diet and activity levels, as these can change rapidly and whimsically in this age group. Emphasize the importance of consistently eating a calcium-rich diet and obtaining adequate levels of physical activity on a daily basis.

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Vitamin D:

A New Look at an Old Vitamin

New research is expanding our knowledge of the metabolic functions and physiologic needs for vitamin D, beyond its traditional role in calcium absorption and bone health. For this reason, the Institute of Medicine (IOM) recently convened a committee to examine the research and update their dietary recommendation for this all-important nutrient. This monograph will provide the health professional with an overview of the new areas of research, a summary of the recently updated recommendations and practice points to optimize the vitamin D status of patients and clients.

Basics of vitamin D synthesis

Vitamin D is the only vitamin the human body makes itself in any significant amounts. Previtamin D₃ is synthesized in the skin following exposure to UV-B sunlight. The “storage form” of vitamin D, hydroxy vitamin D [25(OH)D], is then synthesized in the liver and circulates in the blood. Finally, di-hydroxy vitamin D [1,25(OH)₂D], the “active form” of vitamin D (also called calcitriol), is synthesized in the kidney to support calcium balance and in other cells when and where it is needed.

Because of the sun’s contribution to vitamin D status, the “completely avoid sun” message has been liberalized by the American and Canadian Cancer Societies.^{1,2} Depending on location, time of year, age and amount of melanin in one’s skin, it is now encouraged to get 5 – 30 minutes of sun exposure between 10 am and 3 pm at least twice a week on the face, arms, legs or back, without sunscreen, for sufficient vitamin D synthesis.³ Since it is fat-soluble, vitamin D can be stored for several months when people are not exposed to sunlight.

Problems in relying only on sun exposure for vitamin D, however, include that little or no synthesis takes place in winter at latitudes above 40°N (north of Columbus, Ohio) and sunscreen SPF greater than 8 blocks UV-B, as does clothing, smog, being indoors and darker skin pigments. Additionally, synthesis declines as we age.

Physiologic functions of vitamin D— Traditional

Vitamin D is best known for its role in tightly regulating serum calcium levels by enhancing calcium absorption and increasing bone resorption, as part of a process involving parathyroid hormone (PTH). Thus, classic vitamin D deficiency results in bone demineralization, which can ultimately lead to rickets in children and osteomalacia or osteoporosis in adults.

As calcium also helps maintain muscle strength, vitamin D deficiency results in leg muscle weakness and an increase in falls in older people.

A recent meta-analysis indicated that intakes of 700 – 800 IU of vitamin D per day, or only slightly higher than the current recommendation, could prevent about one-quarter of all hip and nonvertebral fractures in both ambulatory and institutionalized older persons.⁴ There is evidence that higher concentrations of serum vitamin D may also contribute to peak bone mass in younger adults, which could protect against fractures at an older age.⁵ Higher blood levels of vitamin D are also associated with lower rates of hip fracture and reduced risk of falling.⁶

There are numerous studies showing vitamin D supplementation has positive effects on bone mineral augmentation in children and adolescents. Even maternal vitamin D status during pregnancy influences the bone growth of the offspring and their risk of osteoporosis in later life.⁷ In the past few years, nutritional rickets has re-emerged in the U.S. as a public health concern. One review identified 166 cases of rickets among children four months to 4-1/2 years of age between 1986 and 2003, most of whom were African American, breastfed, and very few of whom were given supplements.⁸ Rickets has also been reported in adolescents,⁹ leading experts to suspect that many other children and adolescents have borderline or undetected deficiencies.

Experts believe the cause for this resurgence in cases of rickets is multi-factorial and includes the following:

- Children tend to be outdoors less, favoring indoor activities such as watching television and computer-related activities.
- Liberal use of sunscreen minimizes vitamin D synthesis in the skin.
- Living among tall buildings in urban environments results in less sunlight exposure.
- Many children have poor diets and do not consume enough dietary sources of vitamin D, such as fortified dairy products.
- Adolescents in particular often trade milk consumption for soft drinks at a time when bone mass is accumulating rapidly.
- **Dark-skinned individuals don’t absorb sunlight as easily as Caucasians and are more prone to vitamin D deficiency.**

Physiologic functions of vitamin D— Emerging

Extensive research is uncovering other non-traditional functions and benefits of vitamin D in the body. Significance of nontraditional roles emerged when it was discovered that cells other than the kidney could make the active form of vitamin D for their own use. In these cells, calcitriol acts to regulate gene expression. Those areas with the most substantiation are summarized below.

Cancer

Vitamin D insufficiency affects normal cellular proliferation and differentiation and may thus affect risk of cancer. Observational evidence suggests that people who get little or no exposure to sun tend to have higher rates of breast, colon, pancreatic, ovarian and prostate cancers; some experts believe this is the result of marginal vitamin D status.

Most of the evidence showing a protective effect of vitamin D on cancer has been from observational studies. In the Health Professionals Follow-Up Study, 4,286 incident cancers (excluding prostate and non-melanoma skin cancer) and 2,025 deaths from cancer were documented between 1986 and 2000. Lower vitamin D status, estimated from intake and outdoor activity, was associated with higher risk of most cancers.¹⁰ Epidemiological studies have found that individuals who have suboptimal serum vitamin D levels have a 30 to 50 percent greater risk of colon, prostate and breast cancers, as well as higher mortality rates from these cancers.¹¹

One of the few clinical trials conducted on vitamin D and cancer risk was a 4-year randomized controlled trial of postmenopausal women given calcium alone, calcium plus vitamin D, or placebo. The calcium-only and the calcium-plus-D groups had 45 to 60 percent lower rates for all cancers compared with the placebo group; the calcium-plus-D group also had significant improvements in blood levels of vitamin D.¹²

The strongest evidence for a protective effect of vitamin D against a certain type of cancer is with colorectal cancer. Not only do rates of colorectal cancer rise with increasing distance from the equator,^{13,14} but higher serum vitamin D levels and higher intakes are independently associated with reduced risk.^{15,16}

Immune Function

Vitamin D insufficiency has been linked to an increased risk of tuberculosis and pneumonia,

bacterial infections of the lungs and gingivitis. The active form of vitamin D, calcitriol, is believed to mediate immunological effects by binding to nuclear vitamin D receptors (VDR) present in most immune cells, which in turn increases expression of defensive genes.

A number of autoimmune diseases, such as multiple sclerosis, type 1 diabetes, systemic lupus and rheumatoid arthritis, are associated with vitamin D deficiency,¹⁷ possibly by impairing the development of regulatory T cells. Rates of multiple sclerosis increase with distance from the equator, suggesting that populations with lower vitamin D levels are at increased risk. New research also indicates that higher levels of vitamin D in the blood may lower the risk of multiple sclerosis.¹⁸ Finally, low vitamin D levels have been linked to an increased incidence of upper respiratory tract infections¹⁹ and it is thought that vitamin D may play a role in maintaining innate immunity²⁰ and preventing infection.²¹

Most of the evidence for an effect of vitamin D on immunity, however, stems from epidemiological research and observational studies. Randomized clinical trials to provide definitive associations and quantifying optimal intake and serum levels of vitamin D are still lacking.

Insulin Resistance, Type 2 Diabetes and Metabolic Syndrome

More recently, research has focused on the association between vitamin D and insulin resistance and metabolic syndrome (MetS). Vitamin D deficiency has been shown to alter insulin synthesis and secretion in both humans and animal models, and appears to predispose to glucose intolerance, altered insulin secretion and type 2 diabetes mellitus.²² Vitamin D may thus play an important role in the pathogenesis of type 2 diabetes.

In a recent study in middle-aged and older Chinese population, low serum vitamin D levels are associated with an increased risk of MetS and insulin resistance.²³ A similar study in Asian Indians, however, found no such association.²⁴ Likewise, another study found that vitamin D intake is associated with insulin sensitivity in African American, but not European American, women.²⁵ Such results indicate there may be population-specific associations between vitamin D status and insulin sensitivity, possibly explained by genetics, body composition, lifestyle or a combination of factors. Clinical-intervention trials are needed to confirm these provocative findings.

Vitamin D recommendations

For the first time, the IOM developed Recommended Dietary Allowances (RDAs) for vitamin D in 2010.²⁶ Prior to this, Adequate Intake (AI) levels—rougher estimates of people’s requirements—had been set*. The new values are based on more information and higher-quality studies than were available when the previous values were established in 1997. Because the amount of sun exposure varies greatly from person to person, the recommendations assume minimal sun exposure and are as follows:

Age (yr)	IU (or ug) per day
1 - 70	600 (15)
>70	800 (20)

Pregnant and lactating women are recommended to consume 600 IU per day regardless of age.

The Upper Level (UL), set at 4,000 IU/day for everyone over 9 years of age, represents the safe boundary at the high end of the scale. Intakes consistently above this level are considered to increase one’s risk for harm, such as kidney and tissue damage and other adverse health effects.

Basis for recommendations

Serum vitamin D level is considered the best indicator of vitamin D status as it represents that produced cutaneously and that obtained from the diet. However, there is no consensus in the medical community as to the level needed for optimal health. For purposes of setting the recommendation, the IOM committee considers 20 nanograms per milliliter (ng/ml) adequate for bone health—substantially lower than many groups have defined as the level for vitamin D deficiency/sufficiency.

Using the serum level of 20 ng/ml set by the IOM, blood levels of vitamin D are deemed adequate in almost all individuals, in spite of national intake surveys suggesting that most people do not consume the recommended amount of vitamin D. Data from NHANES III, for example, indicate the average intake for adults from food alone falls in the range of 160 – 240 IU/day^{27,28} and intake from foods plus supplements is 220 – 380 IU/day.^{29,30} It could be that sun exposure contributes meaningful amounts of vitamin D and helps most people meet their needs. Older individuals, those living in institutions and those who have dark skin preventing adequate vitamin D synthesis may still not be meeting their needs, however.

The IOM committee urges people to be cautious in getting their vitamin D status assessed through independent laboratories. Labs tend to use different cut-off points for measuring sufficiency and deficiency and often falsely categorize people as deficient. Overestimating vitamin D deficiency in this way can inappropriately lead people to assume that they need supplements, thereby increasing their risk of toxicity.

Meeting vitamin D recommendations through food versus supplements

Vitamin D is not plentiful in the American diet. Fortified milk is a major source in the U.S.; fatty fish such as salmon, tuna and sardines are also good sources. Some orange juices, margarines, and breakfast cereals are also fortified with vitamin D.

The IOM encourages people to take in vitamin D from foods rather than supplements. Not only can supplements lead to over consumption, they can result in an incomplete “package” of nutrients for health benefits—for example, calcium, phosphorus and other nutrients needed in appropriate ratio for bone health. Some groups such as the elderly, however, may require a supplement to meet their needs if their intake is inadequate and they do not get enough sun exposure. In addition, people with milk allergy, lactose intolerance and those who are strict vegetarians are at high risk for deficiency and may need supplements.³¹ Finally, individuals with a body mass index (BMI) greater than 30 often have low levels of blood vitamin D, as subcutaneous fat is thought to sequester the vitamin, taking it out of circulation.³²

Below is a chart of vitamin D content of some common food sources.³³

Vitamin D	(IU)
Salmon, cooked (3.5 ounces)	360
Sardines, canned (1.75 ounces)	250
Tuna, canned (3 ounces)	200
Milk (1 cup)	100
Vitamin D-fortified orange juice (1 cup)	100
Soy beverage (1 cup)	100
Margarine, fortified (1 tablespoon)	60
Breakfast cereal, fortified (1 serving)	40 (varies)
Egg (1 whole)	20

Multivitamin supplements generally provide between 200 and 400 IU per tablet; single vitamin D supplements can provide up to 2,000 IU. Fish liver oils contain up to 1,300 IU but are also high in vitamin A, carrying risks of vitamin A toxicity.

The role of the practicing health professional

The health professional is in an ideal position to monitor and assess vitamin D status in clients of all ages, considering their current health and future disease risk, and to encourage appropriate sources of this important nutrient. In evaluating vitamin D status in clients:

- Consider skin pigmentation, use of sunscreen, time spent outdoors and latitude. Individuals who are dark skinned, use sunscreen liberally, are indoors much of the time and live in northern areas should be counseled to consume adequate dietary sources of vitamin D.
- Assess calcium intake simultaneously for its impact on bone health. Keep in mind that not all foods high in calcium have vitamin D, and that adequate calcium intake does not replace the need for vitamin D; both are required for optimal health.
- Recommend a vitamin D test [serum 25(OH) D] from a reputable laboratory if there is uncertainty as to intake or status. Use the IOM value of 20 ng/ml to assess status.
- Listen for complaints of bone or muscle pain (which may indicate osteomalacia).

- Encourage food and fortified food sources of vitamin D first, then supplements. Remind clients that foods provide a “package” of nutrients that is generally in the appropriate ratio needed by the body. Compliance can also be an issue when supplement use is inconsistent. Remember that even with a healthy diet, older individuals and other subgroups may need to take vitamin D supplements to meet their higher needs.

As the research matures around the various health effects of vitamin D, the consumer will increasingly seek out vitamin D-fortified food products in the marketplace. Being familiar with these sources—including milk, cheese and yogurt, soy beverages, orange juice and cereals—will assist you in making appropriate recommendations to individual clients.

Keep abreast of the research surrounding vitamin D over the next few years so that you will be prepared to answer clients’ questions and concerns and help them optimize their health through individualized dietary plans developed to meet their needs.

*RDA definition: Average daily dietary intake level that is sufficient to meet the nutrient requirements of nearly all (97-98 percent) individuals in a life stage and gender group.
AI definition: The recommended average daily nutrient intake level based on intake of healthy people assumed to be adequate.

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Vitamin D:

What You Need to Know About the “Sunshine” Vitamin

Eating a wide range of nutrient-rich foods is important for good health. One nutrient receiving a lot of attention is vitamin D. New research and updated national recommendations suggest that children and adults eat more vitamin D-rich foods.

Why do we need vitamin D?

- Vitamin D helps your body absorb calcium for good **bone health**.
- Kids need vitamin D to help prevent **rickets**, a childhood bone disease resulting in bowed legs.
- Low vitamin D intakes can also lead to weak bones in adults, called **osteomalacia**.
- Vitamin D may help reduce risk of **cancers** such as breast, colon and prostate.
- Vitamin D may also help prevent **multiple sclerosis** and **rheumatoid arthritis**.
- New research suggests that vitamin D may boost the **immune system** and help control our blood sugar levels—which may help prevent **diabetes**.

Where do we get vitamin D?

Good food sources of vitamin D include fortified milk and yogurt and fatty fish such as salmon, tuna and sardines. Other foods such as orange juice, margarine and breakfast cereals may be fortified with vitamin D. The chart below lists good food sources of vitamin D.

Vitamin D is often referred to as the “sunshine” vitamin because our bodies can make it when we are out in the sun. About 5 – 30 minutes of sun twice a week on our face, hands and arms—without sunscreen—is enough to meet our needs. And it is stored in our body for the days and weeks that we do not get enough sun. Although most of us get enough vitamin D from food and sun exposure, some people may not be able to: those who live in northern states, are not outside often, are older or have dark skin.

Vitamin D (IU)	
Salmon, cooked (3.5 ounces)	360
Sardines, canned (1.75 ounces)	250
Tuna, canned (3 ounces)	200
Milk (1 cup)	100
Vitamin D-fortified orange juice (1 cup)	100
Soy beverage (1 cup)	100
Margarine, fortified (1 tablespoon)	60
Breakfast cereal, fortified (1 serving)	40
Egg (1 whole)	20

How much do we need?

The following recommendations were set by the Institute of Medicine (IOM) to ensure good bone health:

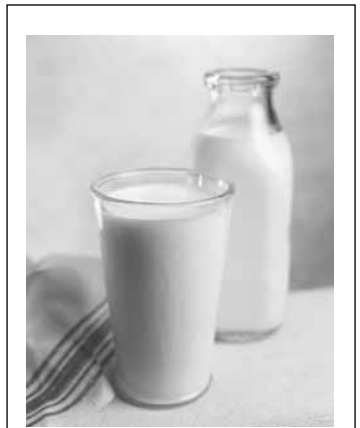
Vitamin D (IU)	
Children and adults up to 70 years	600
Adults older than 70	800

No one should have more than 4,000 IU per day.

The IOM encourages people to get their vitamin D from foods rather than supplements. Very high doses of vitamin D (above 4,000 IU per day) can cause kidney and tissue damage and other harmful health effects.

Simple ways to boost your intake:

- Aim for 3 cups of vitamin D-fortified milk a day.
- Use milk instead of water in making hot chocolate, soups and sauces.
- Choose vitamin D-fortified yogurts, cheese and orange juice whenever possible.
- Check labels and choose breakfast cereals that are fortified with vitamin D.
- Include tuna on a regular basis, in sandwiches, casseroles or salads
- Grill or bake salmon for a vitamin D-rich meal, once a week if possible.



An easy way to get your recommended vitamin D and other important nutrients is to base your eating pattern on nutrient-rich choices from all five food groups: low-fat milk and dairy foods; lean meats, beans and nuts; whole and enriched grains; fruits and vegetables.

Visit www.mealsmatter.org to find recipes using vitamin D-rich foods.



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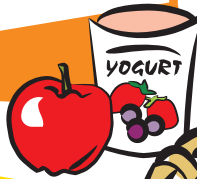
Eat Well, Be Active!

Here are some of the great things that eating well and exercising regularly can do for you!



Put a check by the things that are important to you:

- feeling good about myself
- being healthy
- growing as tall as I'm supposed to be
- doing better in school
- sleeping better
- having more energy to do all the things I want to do



	9-11 year-olds	12-18 year-olds
Milk	3 cups	3 cups
Fruits	1½ - 2 cups	2 - 2½ cups
Vegetables	1½ - 2½ cups	3 - 3½ cups
Grains	5 - 6 ounces	7-10 ounces
Meat & Beans	4 - 5½ ounces	6 - 7 ounces

What do you think healthy eating means?

Eating well means enjoying all kinds of foods from all of the food groups represented in the MyPyramid chart (above). Each food group supplies different vitamins, minerals and other nutrients that keep you healthy. Eliminate a food group and you lose those nutrients!



Move your body! Instead of watching television or playing video games try to trade some of your free time every day to do things that get your body moving. Playing sports, dancing, riding a bike or walking to a friend's house will help keep your mind sharp and your body healthy.

Bone up on calcium!

If you're like most teens, you're probably getting nowhere near the calcium you need to look and feel your best.

You can't see it on the outside, but right now your skeleton is undergoing major construction.

Between the ages of about 11 and 20, you'll build up more than half your total adult bone calcium supply.

You need calcium to build and maintain strong bones. Dairy foods, such as milk, provide protein, vitamins A and D, calcium, magnesium and potassium – all of these help make your bones strong.

See the tips on the next page for ways to boost your calcium intake.

Here's what you can do to eat better!

Put a check by all the things you will try. Tell a friend or your mom or dad what you plan to do. They can help you stick to a plan.



- I will listen to my body and eat when I'm hungry and stop when I'm full.
- I will eat regularly. I will start off my day with breakfast and try to eat three meals a day, plus some nutritious snacks.
- I will try to eat many different foods from all of the food groups, including milk, cheese, fruits, vegetables, breads, cereal, rice, pasta, meats, beans and nuts. I'll even treat myself to sweets and desserts sometimes.
- I will eat with my family and friends more often.
- Whether I feel sad, lonely, upset or happy, if I'm not really hungry, I'll find something else to do instead of eating.



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5 Easy Steps to Stronger Bones...Go for It!

Step 1: Are you eating enough bone-building foods?

Circle the calcium foods you usually eat on most days.

HIGH-CALCIUM FOODS

Portion Size: 1 cup milk, yogurt, pudding; 1½ oz. cheese

Fat-free or low-fat milk
Fat-free or low-fat flavored milk
Fat-free or low-fat yogurt
2% milk
String cheese
Cheese
Pudding or custard

MEDIUM-CALCIUM FOODS

3 medium-calcium foods =

1 high-calcium food

Portion Size: ½ cup

1/8 of a 12" pizza
Tofu (calcium-set)
Corn tortillas (2)
Broccoli
Refried beans
Almonds (1/4 cup)



Step 4: How to get more calcium, no matter how busy your lifestyle!

- Start your day with a healthy breakfast!** Try a breakfast smoothie using frozen fruit, yogurt and milk. Eat cereal for breakfast.
- Drink milk** at meals instead of soda or other empty calorie drinks.
- Eating at fast food restaurants?** Have cheese on your burger, chicken or fish sandwich • Opt for the salad bar and choose vegetables and beans topped with shredded cheese and almonds • A bean and cheese burrito or a couple of tacos will do the trick too!
- Pack some snacks** in your backpack for school and after-school activities. Take along fresh vegetables, fruit and string cheese, some almond granola or a pudding cup.
- Vegetarian?** Get your calcium from milk and dairy foods, dried beans, nuts and calcium-rich vegetables. How about a mozzarella cheese and roasted-vegetable pizza?

Step 2: How much calcium do you need?

AGE	CALCIUM NEEDED	DAILY HIGH-CALCIUM FOODS NEEDED
9-18 years	1,300 mg.	3

Step 3: Are you getting enough calcium every day?

YES NO

Look at the lists above.

- What one or two changes could you make to get more high-calcium foods every day?
- Which foods could you eat more of or more often?
- Which foods could you add? When?
 - Meals
 - Snacks

Step 5: Don't forget exercise!

Do you get 60 minutes of exercise every day, some of which is bone-building?

YES NO

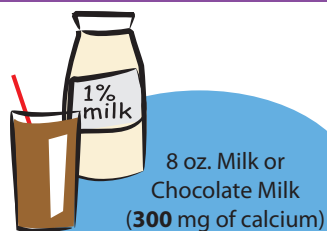
- Bone-building means activities that put the weight of your body on your bones. Walking, jogging, dancing, aerobics, or team sports such as soccer or basketball are good for the bones.
- Walk or roller-blade to school instead of riding in a car. Pick up the pace when strolling through the mall. Take the stairs instead of the escalator.
- Exercise with a friend — it's more fun and easier to stick with.

Did you reach your daily goal of 3 servings? 1300 mg. or 3 servings is your daily goal.

Here are a few ways to get some of your 3 servings of calcium-rich foods each day through beverages. Check off the ones that you can see yourself adding to your day:

- Drink milk at meals instead of juice or soda.
- Try a breakfast blender smoothie using frozen fruit, yogurt and milk.
- Grab a low-fat chocolate milk instead of drinking soda.

Small changes add up to big results!



VS

8 oz. Cola, 8 oz. Sports Drink or 8 oz. Fruit Drink (0 mg of calcium)



Sounds good, but...

What if I don't drink milk or milk products because I have trouble digesting them? There are some things you can do if you have trouble digesting milk (lactose intolerance):

- Drink low-fat or fat-free milk in servings of 1 cup or less.
- Drink low-fat or fat-free milk with other food, such as with breakfast cereal, instead of by itself.
- Eat dairy products other than milk, such as hard cheeses or cottage cheese, or reduced-fat ice cream or yogurt. These foods have smaller amounts of lactose and may cause fewer symptoms.
- Choose lactose-free milk and milk products, which have the same amount of calcium as regular milk.

Bone Health Assessment

Client Name: _____

Date: _____

Age: _____

1. How many times a day do you (or does your child) drink white or flavored milks?
(whole, 2%, 1%, or skim milk) *please circle answer*
0 1 2 3 4 more than 4
2. How often do you (or does your child) eat cheese, yogurt, yogurt drinks, or other dairy products?
 Never Sometimes Daily
3. How often do you (or does your child) drink sweetened drinks (soft drinks, fruit drinks, fruitades, etc)?
 Never Sometimes Daily
4. Do you (or does your child) drink calcium-fortified juices or eat any other calcium-fortified foods such as cereal or bread? How often?
 Never Sometimes Daily
5. Do you (or does your child) eat any of the following: broccoli, beans, cooked greens (eg, collards, turnip greens, kale), or tofu?
 Never Sometimes Daily
6. Do you (or does your child) take any calcium supplements including those containing vitamins?
 Never Sometimes Daily
7. How many times a week do you (or does your child) participate in vigorous weight-bearing physical activity?
 Never Sometimes Daily
8. Have you (or has your child) had any bone fractures? Yes No
9. Is there a family history of osteoporosis? Yes No
10. Was your child born prematurely? Yes No

Health Professional Resources

Optimizing Bone Health in Children and Adolescents:

Implications for Future and Current Health

http://www.dairycouncilofca.org/PDFs/Bone_Health.pdf

This monograph summarizes factors related to bone health and fracture risk and provides specific suggestions for practicing health professionals to assess calcium intakes and optimize the bone health of their young clients.

National Osteoporosis Foundation's Bone Basics on Calcium

http://www.nof.org/sites/default/files/pdfs/BoneBasicsAlert_CalciumBasics.pdf

Scientific Statement developed by National Osteoporosis Foundation to assess calcium intake.

List of calcium content in foods

<http://www.nal.usda.gov/fnic/foodcomp/Data/SR18/nutrlist/sr18w301.pdf>

"Lactose Intolerance: Can Dairy be Part of the Solution?"

http://www.dairycouncilofca.org/PDFs/LactoseIntolerance_web.pdf

This monograph defines lactose intolerance for the health professional and describes prevalence, common symptoms and how to help your clients manage symptoms.

National Digestive Diseases Information Clearinghouse (NDDIC)

<http://digestive.niddk.nih.gov/diseases/pubs/lactoseintolerance/>

This site contains comprehensive information on diagnosis and treatment for lactose intolerance.

A Need for Action: Dietary Guidelines for (Unhealthy) Americans

http://www.dairycouncilofca.org/PDFs/DietaryGuidelines_2010.pdf

This newsletter outlines the 2010 Dietary Guidelines and the need for society-wide efforts to help Americans implement and adopt the new recommendations.

Client Education Resources

National Institute of Health Milk Matters

<http://www.nichd.nih.gov/publications/pubs.cfm?from=milkc-hp>

Client handouts are available through this public health education campaign to promote calcium consumption among “tweens” and teens.

Calcium Connection: Healthy Bodies From One Generation to Another

<http://www.dairycouncilofca.org/HealthProfessionals/ClientPrograms/ProgramCalciumConnection.aspx>

This print program helps your client assess their calcium intake and provides tips on how to meet dietary calcium recommendations across the lifespan.

Grocery List: Shopping for Foods with Calcium

<http://www.cdc.gov/powerfulbones/parents/toolbox/list.pdf>

Handout from the Powerful Bones, Powerful Girls campaign

Calcium Quiz

<http://www.mealsmatter.org/EatingForHealth/Tools/cq.aspx>

This online tool assesses calcium intake in children, teens and adults and provides suggestions for achieving calcium recommendations

Kidnetic

<http://www.kidnetic.com/>

This website includes interactive tools for children that encourage physical activity and healthy eating.

MyPyramid for Kids

<http://www.mypyramid.gov/kids/index.html>

The site includes handouts and interactive web tools for children ages 6 -11.

Eat Well, Be Active

http://www.dairycouncilofca.org/PDFs/bone_health_flyer.pdf

This two sided handout is designed to help children ages 9-18 identify ways they can eat better and become more physically active.

Lactose Intolerance: Separating Myth from Reality

http://www.dairycouncilofca.org/PDFs/Lactose_consumer_web.pdf

Handout on lactose intolerance, symptoms and how to best manage it through diet

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Examination for Bone Health (BHC11)

1. What are two primary risk factors for bone fracture among adolescents?
 - a. Early age at first fracture; low dietary intake of fruits and vegetables
 - b. Avoidance of cow's milk; overweight and obesity
 - c. Late age at first fracture; avoidance of cow's milk
 - d. High calcium intakes; excessive physical activity

2. Children with low calcium intakes have about _____ times the fracture risk compared to birth-cohort controls with adequate intakes.
 - a. Two
 - b. Three
 - c. Four
 - d. Five

3. Postulated reasons for the recent increase in fracture risk among children and adolescents include:
 - a. Decreased physical activity
 - b. Increased physical activity
 - c. Replacement of milk with sodas, juice and fruit drinks
 - d. A and C

4. Fracture incidence in adolescent boys and girls is approximately _____ higher than it was a generation ago.
 - a. 10-20 percent
 - b. 20-40 percent
 - c. 30-60 percent
 - d. Fracture incidence is about the same

5. Adolescence is considered the 'window of opportunity' to optimize bone health because:
 - a. About one-half of total adult bone mass is accumulated during adolescence.
 - b. Fractures in adolescence relate to osteoporosis in later years.
 - c. Adults later in life cannot compensate for inadequate bone deposition in adolescence.
 - d. A and C

6. Studies in pre-teens and teens have found that increasing calcium intake improves bone density, particularly in those:
 - a. Who have experienced a fracture
 - b. With suboptimal habitual calcium intakes
 - c. Who get regular weight-bearing physical activity
 - d. Who do not get enough sunlight exposure

7. The best way to ensure long-term benefits of optimal bone health is to:
 - a. Take daily high doses of calcium supplements
 - b. Become a "weekend warrior" by engaging in excessive exercise on weekends
 - c. Sustain adequate calcium intakes throughout one's lifetime
 - d. Participate in a 6-month clinical trial that provides a high-calcium diet

8. The recommended intake for calcium in adolescents is:
- 800 milligrams per day
 - 1,000 milligrams per day
 - 1,200 milligrams per day
 - 1,300 milligrams per day
9. Most US government agencies and health organizations highlight dairy as the primary source of calcium, recommending _____ cups of dairy per day in adolescence and adulthood.
- 1-2
 - 2-3
 - 3-4
 - 4-5
10. Symptoms of lactose intolerance can generally be managed by:
- Drinking milk with meals
 - Consuming yogurt and hard cheeses
 - Consuming small amounts of dairy throughout the day
 - All of the above
11. Dietary factors that positively influence bone health include:
- Vitamin D, protein and magnesium
 - Vitamin D, vitamin E and potassium
 - Vitamin A, magnesium and phytates
 - Oxalates, caffeine and sodium
12. Two non-dietary factors that influence bone health are:
- Radiation exposure and body weight
 - Certain medications and activity level
 - Activity level and latitude
 - Smoking and alcohol consumption
13. American Academy of Pediatrics (AAP) recommends assessing calcium intake at least _____ times during childhood and adolescence.
- Two
 - Three
 - Four
 - Five
14. Dietary factors that may negatively impact bone health include:
- Excessive caffeine intake
 - Alcohol consumption
 - High levels of oxalates and phytates
 - All of the above

15. Six out of 10 adolescent boys and nine out of 10 girls do not consume adequate calcium.
- True
 - False
16. Weight-bearing physical activity constitutes activities such as:
- Running, jogging, walking and aerobics
 - Swimming, cycling, running and walking
 - Cycling, Stairmaster, weight-lifting and jogging
 - Soccer, basketball, swimming and water polo
17. Assessment of a client's calcium status should start by asking:
- Do you (or does your child) use calcium supplements on a regular basis?
 - Do you (or does your child) consume calcium-fortified foods?
 - How many times a day do you (or does your child) drink white or flavored milks?
 - How much sunlight exposure do you (or does your child) get?
18. To increase calcium content modestly in a client's diet, you might suggest:
- Encouraging foods such as beans, nuts, broccoli, dark green leafy vegetables
 - Offering cheese and yogurt at snack time
 - Making yogurt-based fruit smoothies
 - All of the above
19. The 2010 Dietary Guidelines recommend that children and adolescents participate in at least _____ minutes of moderate-intensity physical activity most days of the week, preferably daily.
- 30
 - 60
 - 90
 - 120
20. A comprehensive questionnaire to assess calcium status in children and adolescents is available from:
- American Academy of Pediatrics (AAP)
 - United States Department of Agriculture (USDA)
 - Centers for Disease Control (CDC)
 - American Dietetic Association (ADA)