Interview with Professor Connie Weaver

Connie Weaver is Distinguished Professor and Head of the Department of Foods & Nutrition at Purdue University, Indiana USA.

How does body fat affect bone health in adolescents?
We know that the incidence of fractures in this age group has doubled in the last three decades, and that this serious clinical outcome reflects the state of their bone health. The data suggest it is connected to the increasing body fat and body weight of teenagers.

This makes sense because, at the very least, when your body weighs more, you will need a larger, stronger bone skeleton to support that weight, and if you fall the trauma and impact will be greater. There may be other mechanisms as well, for example a change in the hormonal environment caused by obesity that could trigger switching in the cellular differentiation that affects bone development, but that is still at the early stages of investigation.

Yet even in normal weight adolescents we know that many do not have good bone geometry. What is clear is that calcium and dairy intake is a critical factor. In fact we are just starting a new randomised clinical trial to test whether more dairy will grow more bones particularly in those higher BMI teenagers.

What about in adolescents who are actively trying to lose weight?
The research showing that calcium and dairy intake can help prevent bone loss when people are actively losing weight comes from adults, but there is no reason to think this would not apply to teenagers also. So it would be prudent to ensure that they do not restrict these foods when they are dieting. Teenagers do tend to `cut calories' unselectively, and the one place you don't want to cut is in relation to calcium.

When I was in Australia recently, I saw the results of the latest national dietary survey. The proportions of children and teenagers not meeting their recommended calcium intakes was shocking – so this is an exceedingly important issue.

Does this suggest that the recommended levels are too high?
Not at all, these levels are based on our best evidence. The thing is, although we have all these data relating the normal distribution of bone density to fracture rates, the data is mainly from the older population. But we may be missing a lot of fractures that are happening in younger people. And even in the older age group, the majority of fractures occur in the moderately below-average BMD range (0.5 to 1.5 standard deviations below the mean).

Are all calcium sources of equal value in promoting bone health?
The evidence is stronger for dairy than for calcium supplements on their own. Bones don't just need calcium, and of course vitamin D. There is also the protein, phosphorus, magnesium, potassium, and (to a lesser extent) riboflavin. Dairy foods have a whole package of nutrients, whereas a supplement only has what is in that supplement. So if you don't consume dairy your chance of getting the whole nutritional balance that bones need in one place is pretty slim.

What about the Winzenberg meta-analysis[3]?
Obviously they did get the results they got, but I am not sure whether the conclusion should be taken to have clinical application. Not only was the focus on bone density not the best measure in the growing adolescent, but in the RCTs they analysed there was insufficient information on the background diet and how much calcium was actually being retained. Some research shows the particular value of higher dairy intake.

So what should clinicians be telling teenagers?
In my experience, many teenagers and young adults understand the general point that calcium is needed for healthy bones. But they have no idea how much calcium, or how poor their own diets are in relation to this, hence they don't translate their general awareness into any practical action. Even some of the 18 year olds we see are already losing bone!

So clinicians need to be proactive in enquiring with teenagers about their physical activity and their diet, specifically asking them about how they get their calcium. Drinking a glass of milk with meals would be a good start! And physical weight-bearing activity is also crucial, because the calcium will not be properly utilised by bones until this weight bearing activity tells them that they need it.

Shake and Smoothie Sensations

Milkshakes and smoothies are a great way for teenagers to include dairy in their day.

Triple Strawberry Sensation

Serves: 1 teenager or adult

Ingredients:

200g tub low fat strawberry yogurt
1/2 cup reduced fat milk
1/2 cup chopped strawberries

Method:

1. **Chop one strawberry into thin slices and press these onto the inside of a tall glass**
2. **Blend remaining ingredients together until smooth.**
3. **Pour into glass and serve with a straw.**

Nutrition Information:

Nutrient	Per Serve (259g)	Per 100g
Energy (kJ)	664	213
Protein (g)	11.6	3.8
Total Fat (g)	2.1	0.7
Saturated Fat (g)	1.3	0.4
Carbohydrate (g)	21.9	7.0
Sugars (g)	21.9	7.0
Dietary Fibre (g)	1.8	0.6
Sodium (mg)	128	41
Calcium (mg)	368	118

Here are some other quick and nutritious smoothie ideas to encourage teens to try. Simply add the following ingredients to 100g reduced fat vanilla or natural yogurt and ½ cup reduced fat milk:

- **Mango and banana**
- **Strawberry and honey**
- **Banana and strawberry**
- **Passionfruit and banana**
- **Blueberries**
- **Unsweetened crushed pineapple**
- **Canned peaches (or apricots) and cinnamon**

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More than meets the eye

It is not just the calcium in dairy foods that makes an important contribution to the nutritional health of bones. Some new studies have illustrated this fact.

Potassium is a nutrient that some may not associate either with bone health or with dairy. Yet potassium does have a role to play in bone development, for example in relation to calcium retention[11], and dairy foods are an important source of potassium. A recently published analysis from the US National Health and Nutrition Examination Survey[12], has shown that potassium intake increases with increasing dairy intake in a step-wise fashion, and that the percentage of the recommended requirement of potassium that a person's diet contains is significantly greater in those consuming the recommended serves of dairy food than in those who do not. This was true across the age groups.

So, for example, only 6% of those consuming dairy 1-1.5 times/week met their potassium recommended intake, whereas 18% of those having 3.5-4.5 dairy serves did so. The mean potassium intake in 2-8 year olds who met dairy intake recommendations was significantly higher than those of the same age group who did not (2,414 vs 1,574 mg/day, $p<0.05$).

Protein is another crucial element in the health of adolescent bone, and a recent study from Denmark[13] adds weight to what was suggested by the Framingham Children's data (see graph 2 on page 2), that the protein in dairy may have particular impact not seen with other types of protein. In a cross-sectional study of 109 seventeen year olds, based on a 7 day diet record, total and milk protein intake, but not meat protein intake, were correlated with BMC, after correction for calcium, energy and physical activity levels ($p<0.01$). The authors suggest that components of milk protein may promote bone mineralisation.

This conclusion was extended by the results of a controlled trial conducted by the same Danish research group[14] on 28 eight year old boys, assigned to eat either a high milk or a high meat diet of equal protein content. After 7 days, the high milk group had significantly lower measures of bone turnover than the high meat group (osteocalcin, and C-terminal teleopeptides of type 1 collagen, $p<0.05$). This result may have been due to milk-derived peptides or the milk related difference in mineral content of the diets.

References:
11. Lanham-New SA The balance of bone health: tipping the scales in favor of potassium-rich, bicarbonate-rich foods. J Nutr. 2008 Jan;138(1):172S-177S.
12. McGill CR, et al. Contribution of dairy products to dietary potassium intake in the United States population. J Am Coll Nutr. 2008 Feb;27(1):44-50.
13. Budek AZ, et al. Dietary protein intake and bone mineral content in adolescents- The Copenhagen Cohort Study. Osteoporos Int. 2007 Dec;18(12):1661-7. Epub 2007 Jul 17.
14. Budek AZ, et al. High intake of milk, but not meat, decreases bone turnover in prepubertal boys after 7 days. Eur J Clin Nutr. 2007 Aug;61(8):957-62. Epub 2007 Jan 17.

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DAIRY NutritionNEWS
Better health through dairy foods
Dairy Australia

MARCH 2009

Welcome

This month we are doing something a little different from our past issues. Instead of having articles on several topics, we have gone into more depth on a single topic – healthy bones for adolescents and the vital role dairy food intake plays in relation to this. We consider a number of recent studies relevant to this theme, including observational studies and randomised controlled clinical trials. Of great interest are the results from three Australian surveys on the nutrition and physical activity of children. We learn what lessons these have regarding dairy and calcium intake during childhood.
And finally we have some delicious shake and smoothie recipes.
Best Wishes,

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Inside this ISSUE

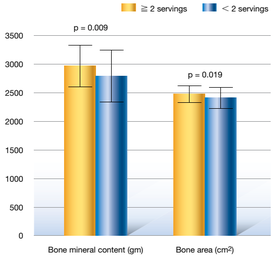
Dairy and bone health in adolescents

Two new research studies have highlighted the long term connection between dietary dairy intake in childhood and adolescent bone health.

The first[1] was a 12 year longitudinal observation from the Framingham Children's Study and involved 84 children whose diets were assessed annually using 3-day diet records, with bone health being tested by dual-energy X-ray absorptiometry (DEXA) scanning at the end (when the subjects were 15-17 years old). Dietary intake was averaged over all the years of observation.

After controlling for potentially confounding factors (such as weight and activity level), the children who had consumed at least 2 serves of dairy a day over the preceding 12 years had significantly higher bone mineral content (BMC) and bone area. The average BMC was 6% higher in these children than in those whose intakes were less than this level. **See Graph 1**.

Graph 1: Bone measures in relation to dairy intake[1]



The authors also looked at the food patterns as a whole, not just at dairy in isolation. Greater consumption of meat and other protein foods (>= 4 serves/day) was also associated with greater BMC, and this was additive to the effect of dairy intake, i.e. the highest BMC was seen in children who consumed higher intakes of both. **See Graph 2.**

The second new publication[2] was a meta-analysis of data from 21 randomised controlled trials on calcium or dairy supplementation and its effect on total BMC in children (they also separately collated data from 10 observational studies).

The combined RCT data showed that such supplementation resulted in a non-significant increase in total BMC, but this was associated with significant heterogeneity. Further analysis revealed that this heterogeneity was to a substantial extent related to baseline calcium intake. Thus, subjects initially consuming normal or near normal initial dietary calcium were not likely to show a benefit from the extra dairy or calcium, whereas those with low baseline intakes showed a significant increase

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It appears that higher calcium intake needs to be maintained through adolescence to maintain the advantages for BMC.

A recent randomised controlled trial[5] tested whether giving calcium supplements to children with low initial calcium intakes would benefit their bones.

The RCT involved 96 girls (average age 12 years) whose initial calcium intake was low (mean value 636 mg/day). They were randomised to receive either placebo or calcium supplements (792 gm/day) for 18 months. During that time, compared to placebo the supplemented girls had significantly greater gains in BMC (total and at various body sites, $p<0.002$), associated with lower levels of osteocalcin ($p<0.001$) and parathyroid hormone ($p=0.013$) However, when the measurements were repeated 2 years after supplementation was discontinued, the differences were no longer evident.

References:
5. Lambert HL, et al. Calcium supplementation and bone mineral accretion in adolescent girls: an 18-mo randomized controlled trial with 2-y follow-up. Am J Clin Nutr. 2008;87:455-62.

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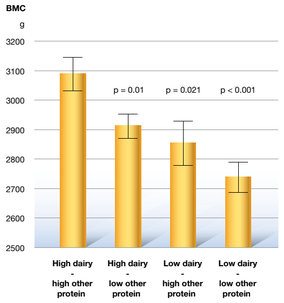
when dairy or calcium was given, both with or without vitamin D.

This most recent meta-analysis makes an interesting contrast to one conducted several years ago[3], the conclusions of which have been subject to some controversy. This earlier analysis included 19 trials on 2,859 subjects, and reported a small although significant effect of calcium supplementation on total bone mineral content and upper arm bone mineral density (BMD). However, as others have pointed out[4], the focus that this earlier review had on BMD as an outcome, along with the absence of a low calcium intake control group in each trial, weakens the validity of the conclusions that the small effect of calcium supplementation on BMD in the upper limb is unlikely to reduce risk of fracture.

References:
1. Moore LL. et al. Effects of average childhood dairy intake on adolescent bone health. J Pediatr. 2008 Nov;153(5):667-73..
2. Huncharek M. et al. Impact of dairy products and dietary calcium on bone-mineral content in children: results of a meta-analysis. Bone. 2008;43 :312-21.
3. Winzenberg TM, Shaw K, Fryer J, Jones G. Calcium supplementation for improving bone mineral density in children. Cochrane Database Syst Rev 2006;CD005119.
4. Heaney R. et al. Letter to the editor. BMJ. 2006;26 September 2006 on-line at http://www.bmj.com/cgi/eletters/bmj.38950.561400.55v1#142714.

Graph 2: Combined effect of intake of dairy and meat and other proteins on bone mineral content[1]



Some teens are at extra risk

All adolescents appear at risk of low calcium intake, but there is evidence that some are more at risk than others.

A potential reason for low calcium intake is that teenage girls may avoid dairy products because they are concerned about their body image, counting calories and believe that dairy foods are high fat and high calorie foods. A Canadian study found evidence for this[6, 7].

The researchers followed 45 healthy girls over 2 years, starting at mean age of 10.5 years. They performed regular assessments of anthropometry, diet and eating attitudes. They found that those girls with higher 'dieting scores' in relation to their eating attitudes had lower total and dairy calcium intakes at baseline (r=-0.39, -0.44 respectively, both p<0.01). The researchers suggested that girls preoccupied with body shape were more likely to exclude calcium-rich dairy foods, which they may have perceived as fattening. Another important finding was that subjects with higher degrees of "oral control" attitudes at baseline predicted BMC both at baseline and over the next crucial two years of early adolescence, accounting in total for up to 8% of the total variance in BMC. Not surprisingly, calcium intake was similarly predictive (up to 5% of the variance).

Teenagers concerned with body image may try to lose weight, which presents another risk for bone health. Can dairy foods help prevent an adverse effect on bone? A recent American trial[8] (although conducted in adults rather than teenagers) has looked at just this question.

A group of 130 subjects (71 of whom were women), all following an energy-reduced diet to lower their weight were randomised to a dietary prescription either for lower protein (0.8 gm/kg/day) and lower dairy (2 serves/day) intake, or for higher protein (1.4 gm/kg/day) and higher dairy intake (3 serves/day). This was kept up for the 4 months of active weight reduction and then a further 8 months of weight maintenance. Bone mineral density (BMD) and content was assessed by DEXA.

At the end of the trial, both groups had achieved an average weight loss of 10% of their initial weight. However, the higher protein/dairy group had significantly higher average BMD than the lower protein/dairy subjects (by 1.4-2.1%, depending on bone site, all p<0.05). Their calcium intake had averaged 1140 mg/day, compared with only 766 mg/day in the comparison group (p<0.01). Bone loss was therefore avoided in the group on higher protein/dairy intake.

Another potential risk factor for young women is the OC pill, which at least one study has found to have adverse effects on bone mineral density when taken by younger women[9]. The possible protective role of dairy foods in young women taking the OC pill was tested in a randomised trial[10] completed by 135 subjects (aged 18-30 years) whose initial calcium intake was less than 800mg/day, some of whom were using the OC pill. They were assigned either to a diet high in dairy (calcium intake 1200-1300 mg/day), medium dairy (calcium 1000-1100 mg/day) or control (calcium < 800 mg/day) for one year, and assignment to these groups was stratified by OC use.

There were two important conclusions from their results. Firstly, OC use did affect bone mineral density. The women taking the OC pill and consuming the lowest calcium intakes lost bone mineral density at both the hip and spine. Secondly, this loss was prevented by higher dairy product intake – for example the control group had a loss of 1.33% of spine BMD compared with an 0.67% gain in the combined dairy groups (p<0.002).

In practice

At least 3 dairy serves/day is recommended for adolescents. Clinicians should be especially vigilant in screening teenagers at extra risk (poor body image, dieting, OC pill).

References:
6. Barr SI (2007) Calcium and body fat in peripubertal girls: cross-sectional and longitudinal observations. Obesity 15, 1302-10.
7. Barr SI. et al. Eating attitudes and habitual calcium intake in peri pubertal girls are associated with initial bone mineral content and its change over 2 years. J Bone Miner Res. 2001 May;16(5):940-7.
8. Thorpe MP. et al. A diet high in protein, dairy, and calcium attenuates bone loss over twelve months of weight loss and maintenance relative to a conventional high-carbohydrate diet in adults. J Nutr. 2008 Jun;138(6):1096-100.
9. Hartard M. et al. Effects on bone mineral density of low-dosed oral contraceptives compared to and combined with physical activity. Contraception. 1997 Feb;55(2):87-90.
10. Teegarden D. et al. Dietary calcium intake protects women consuming oral contraceptives from spine and hip bone loss. J Clint Endocrinal Metab. 2005 Sep;90(9):5127-33

Australian data: the latest

Three recent, large nutrition surveys of Australian children highlight the fact that our teenagers are consuming inadequate amounts of dairy food, and consequently of dietary calcium.

2007 Australian National Children's Nutrition and Physical Activity Survey

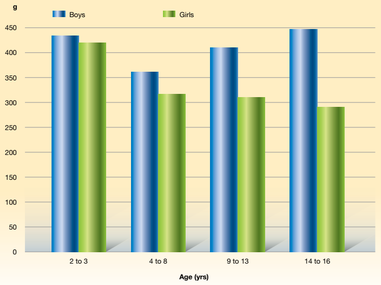
What was done

A national survey was conducted on 4,487 children aged 2 to 16 years between February and August 2007, based on 24 hour recall using both personal and telephone interviews, along with a food habits questionnaire.

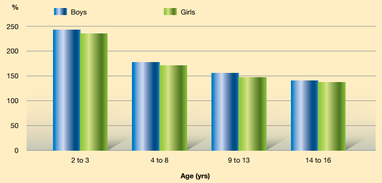
What was found

- The mean dairy intake decreased with age group for girls, for example, total dairy intake was ~30% lower in 14-16 year old than in 2-3 year old girls. On the other hand, in boys it increased with age after 4-8 years of age. **See graph 3.**
- The percentage of dietary energy contributed by dairy foods was similar for both genders, and decreased with age group. (This also reflects the fact that dietary energy intake for boys increases more with age group than for girls). **See graph 4.**
- The mean daily calcium intake increased with age group for both boys and girls. However, because the estimated average requirement (EAR) for calcium also goes up in older age groups, children aged 12-16 years old are least likely to meet that EAR. Amongst girls the proportion is more than three in four (82-89%), whilst in boys it is a little under half (44-50%). **See graph 5.**

Graph 3: Mean dairy food intake at various age groups (2007 National Survey)



Graph 4: Percentage (%) of total dietary energy intake contributed by dairy food (2007 National Survey)



Healthy Kids Queensland Survey 2006

What was done

From April to September 2006, 3,691 school aged children across Queensland in school years 1, 5 or 10 (aged 5-17 years) had anthropometric, physical activity and dietary assessment (food frequency questionnaire plus a 24 hour dietary record).

What was found

- Similar to the national study, dairy food consumption decreased with increasing age for girls but not boys, and the proportion of children consuming less than the EAR for calcium increased with age.
- About half of all year 5 children (43.3% for boys and 55.8% for girls) and more than half in year 10 (50.7% for boys and 87.3% for girls) had diets that contained less than the estimated average requirement (EAR) for calcium for their relevant age and sex group.

NSW Schools Physical Activity and Nutrition Survey (SPANS) 2004

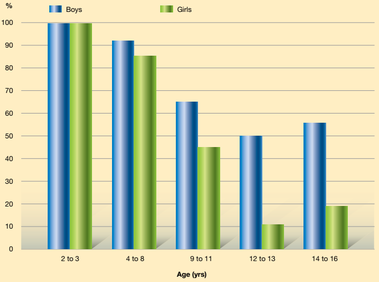
What was done

Around 5,500 children in kindergarten and school years 2,4,6,8 and 10 were surveyed in 2004 regarding body composition, physical activity, and selective aspects of food and eating patterns. In particular, in year 6, 8 and 10 students, the food focus of the questionnaire was around milk but not other forms of dairy food, along with fruit, vegetables, bread, rice, pasta, meat, chicken, fish, fruit juice, soft drinks and confectionary.

What was found

- Significant proportions of boys and girls consumed less than 150mls of milk per day (13%- 19% of boys, ~25% of girls). This included flavoured milk and milk on cereal.
- Soft drink consumption exceeded that of more nutritious beverages. 25% of boys and 20% of girls agreed that they would normally choose soft drinks over water or milk.

Graph 5: Percentage of Children who achieve ≥ EAR for calcium (2007 National Survey)



What does it mean?

These Australian survey results are consistent – children in older age groups consume less dairy foods than children in younger age groups, particularly girls, and at the very time their dietary requirement for calcium increases. The extent to which older children (12 to 16 years of age) meet their calcium requirement is very seriously compromised by decreasing dairy food intake as a proportion of energy intake.

The EAR for calcium is the amount representing the average of the distribution of calcium requirements for an age and sex group. This means that, if requirements are a symmetrical distribution, half of the individuals would have a requirement greater than the EAR, and half less.

The benchmark set by Food Standards Australia and New Zealand (FSANZ) however, is that a population group as a whole has an adequate intake of a nutrient if no less than 3% has an intake below the EAR. Clearly this is not the case in our Australian teenagers. Amongst 12 to 13 year olds, for example, only 11% of girls and 50% of boys reach the EAR intake.

From the food group perspective, the degree of inadequacy of intake in relation to recommendations in this data was about the same order of magnitude for dairy foods as it was with vegetables and fruit, but the impact in relation to key nutrients, particularly calcium, was worse, since dairy food is the primary source of dietary calcium for most of our population.

Current guidelines recommend 2 to 3 serves of dairy food a day, and these results suggest that children should aim for at least the top of this range.