Vitamin D Requirements in Pregnancy/Lactation

Sarah N. Taylor, M.D.
Assistant Professor
Medical University of South Carolina
Darby Children's Research Institute
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Dr. Taylor has no relationships to disclose.

Background

Pregnancy

- Fetus is completely dependent on maternal supply of vitamin D (Mawer EB et al, *Clin Endocrinol* 1986)

Lactation

- AAP recommends exclusive breastfeeding for the first 6 months of life and continuation for at least the first year of life (AAA Policy Statement, *Pediatr* 2005)

Why is maternal vitamin D status important during pregnancy?

- Maternal disease of pregnancy
  - Vitamin D deficiency associated with preeclampsia
    (Bodnar et al, *J Clin Endocrinol Metabol* 2007)

- Fetal growth
  - Positive correlation with head circumference
    (Pawley N et al, *AJCN* 2004)
  - Positive association with birth weight
    (Mannion CA et al, *CMAJ* 2006)

What is maternal vitamin D important during pregnancy?

- Childhood Disease
  - Improved bone mineral content & mass at 9 years (Javaid MK et al, *Lancet* 2006)
  - Relationship with immune function (Zittermann A et al, *Pediatr Allergy Immunol* 2004)
- Adult Disease
  - Multiple Sclerosis (Willer CJ et al, *BMJ* 2005)
  - Schizophrenia (McGrath J et al, *Schizophr Res* 2002; Kirkpatrick B et al, *Am J Psychiatry* 2002)
  - Osteoporosis (Dennison E, *Paediatr Perinat Epidemiol* 2001)

Why is maternal vitamin D status important during lactation?

Infant Vitamin D Intake

- Childhood Growth
  - Positive association with bone mass at 9 years (Zamora SA et al, *J Clin Endocrinol Metab* 1999)

- Childhood Disease
  - Positive association with avoidance of type I diabetes mellitus (Hyppönen E et al, *Lancet* 2001)
  - Positive association with decreased severity of asthma (Camargo CA et al, *AJCN* 2007; Devereux G et al, *AJCN* 2007)

Why is maternal vitamin D intake important for the mother?

Avoidance of-

- Hyperparathyroidism
- Diabetes type II
- Multiple sclerosis
- Rheumatoid arthritis
- Metabolic Syndrome
- Systemic Lupus Erythematous
- Colon Cancer
- Breast Cancer
- Ovarian Cancer
- Endometrial Cancer
- Lung Cancer
- Hypertension
- Falls
- Fractures
- Periodontal Disease
- Osteoarthritis
- Osteoporosis

Promotion of-

- Bone mineralization
- Calcium absorption
- Muscle Strength
- Immune Function

Chapuy 1992 & 1996, Thomas 1998, Lips 2001, Sahota 2004, Jesudason 2002; Dawson-Hughes 1997 & 2004 & 2005, Harris 2000, Vieth 2003, Borissova 2003, Chiu 2004, Scragg 2004, Isaia 1996, Boucher 1995,Munger 2004 & 2006, Merlino 2004, Pereira 2002, Kamen 2006, Lappe 2007, Gorham 2005 & 2007, Feskanick 2004, Wactawski-Wende 2006, Park 2007, Garland 1989 & 2007, Braun 1995, Tangrea 1997, John 1999, Bèrubè 2004 & 2005, Lowe 2005, Bertone-Johnson 2005, Lekfowitz 1994, Mohr 2007, Pfeifer 2000 & 2001, Lind 1988, Li 2002, Fahrleitner 2002, Bischoff-Ferrari 2004 & 2006, Broe 2007, Trivedi 2003, Dietrich 2004, McAlindon 1996, Lane 1999, Papadimitropoulos 2002, Holick 2005, Gaugris 2005, Meier 2004, Heaney 2003 & 2005, Liu 2006, Shauber 2007, Hayes 2003, Harkness 2005, Hollis 2005, Whiting 2005

Vitamin D in Pregnancy

- NIH **R01 HD043921**
  (PI: Bruce Hollis, Co-PI: Carol Wagner)
- 456 patients with baseline circulating 25(OH)D measurement at 12 weeks gestation
- Charleston, South Carolina Latitude 32˚

Circulating 25(OH)D	Black	White	Hispanic
<20 ng/ml, n (%)	96 (77)	17 (12)	62 (33)
<32 ng/ml, n (%)	122 (98)	98 (67)	152 (82)

Vitamin D Supplementation during Lactation

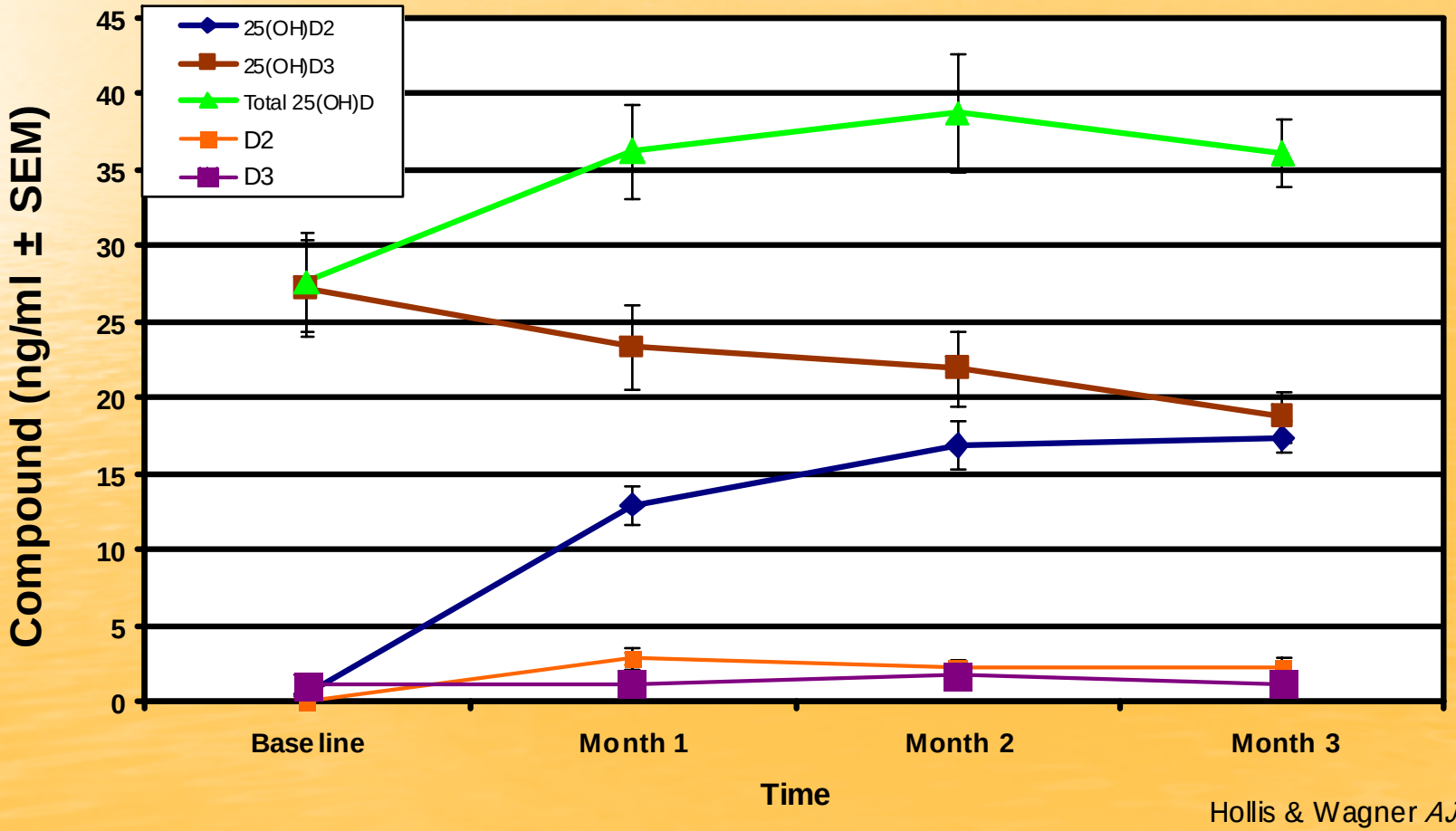
- Current U.S. maternal recommendation: 200 IU/day vitamin D
- In prenatal vitamin: 400 IU/day vitamin D
- **These doses produce breast milk with vitamin D activity of 20-70 IU/L**
- Current U.S. infant recommendation: 200 IU/day vitamin D
- Current U.S. infant formula: 200-400 IU/day vitamin D

Vitamin D Supplementation in Lactation

- For 3 months

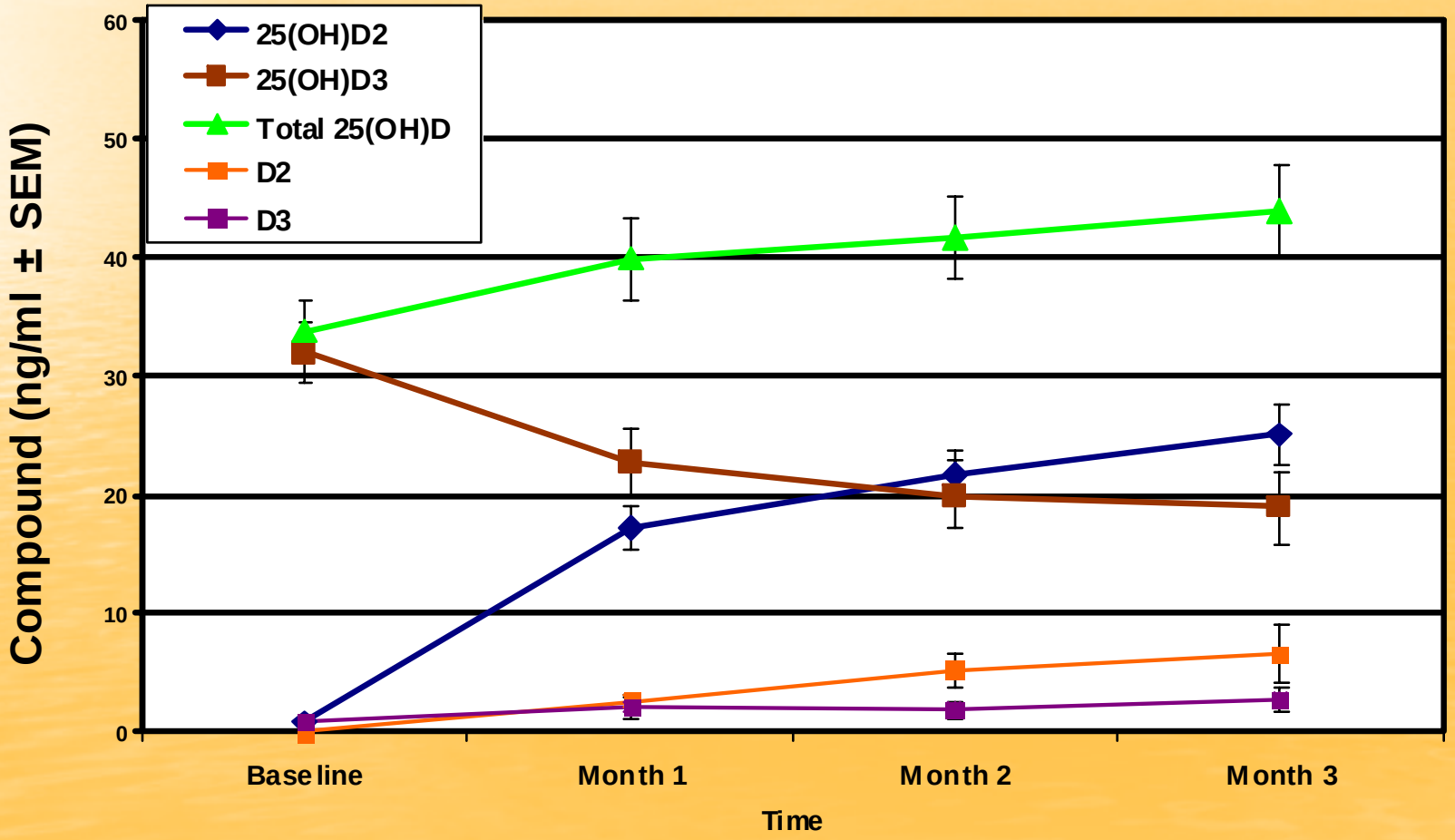
- 9 women received 400 IU/day vitamin D_3 and 1600 IU/day vitamin D_2
- 9 women received 400 IU/day vitamin D_3 and 3600 IU/day vitamin D_2

Circulating vitamin D and 25(OH)D concentrations over time among lactating mothers receiving 1600 IU/day vitamin D_2 and 400 IU/day vitamin D_3



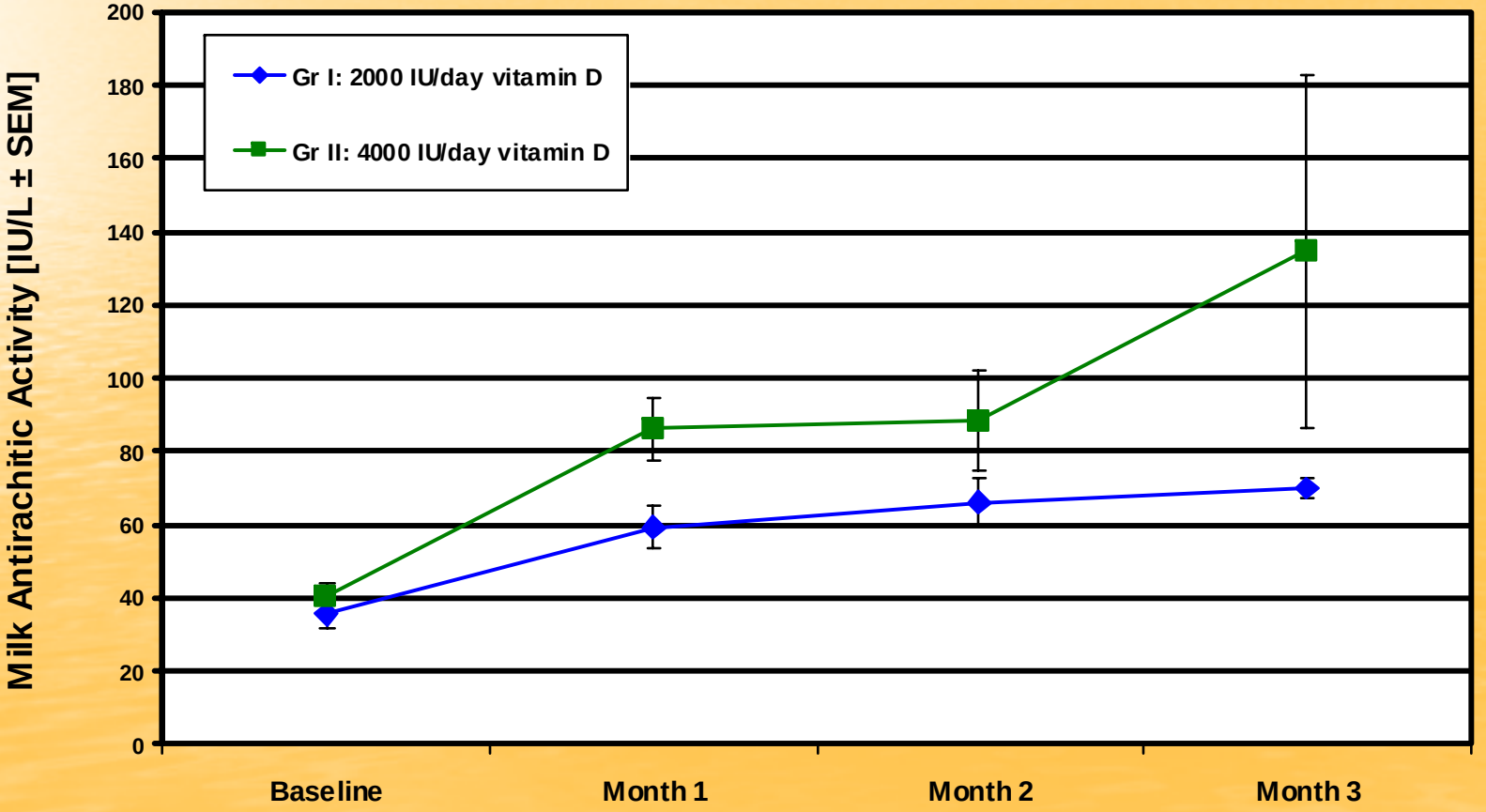
Hollis & Wagner *AJCN* 2004

Circulating vitamin D and 25(OH)D concentrations over 3 months among lactating mothers receiving 3600 IU/day vitamin D_2 and 400 IU/day vitamin D_3



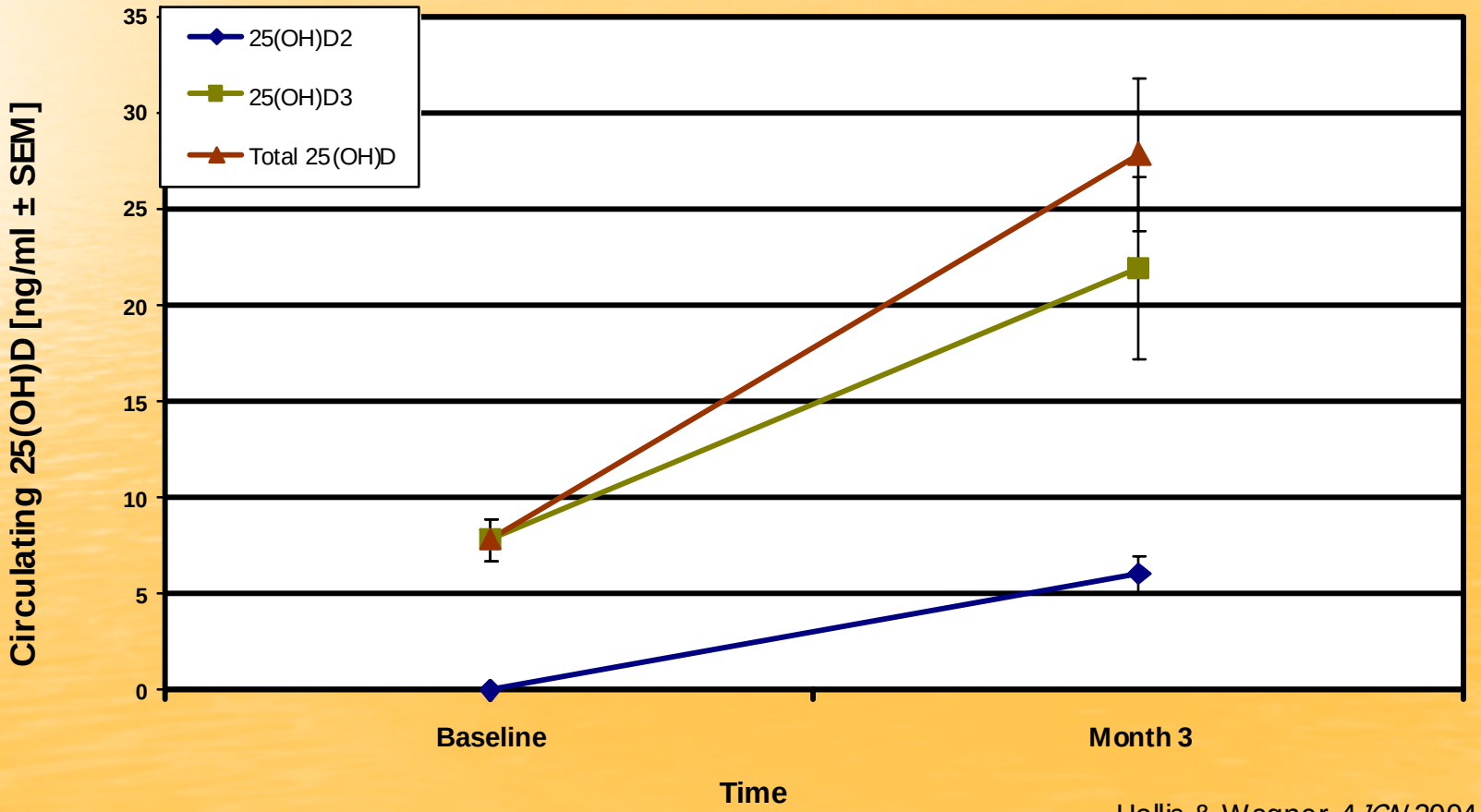
Hollis & Wagner *AJCN* 2004

Milk antirachitic activity over 3 months among lactating mothers receiving 2000 or 4000 IU/d vitamin D



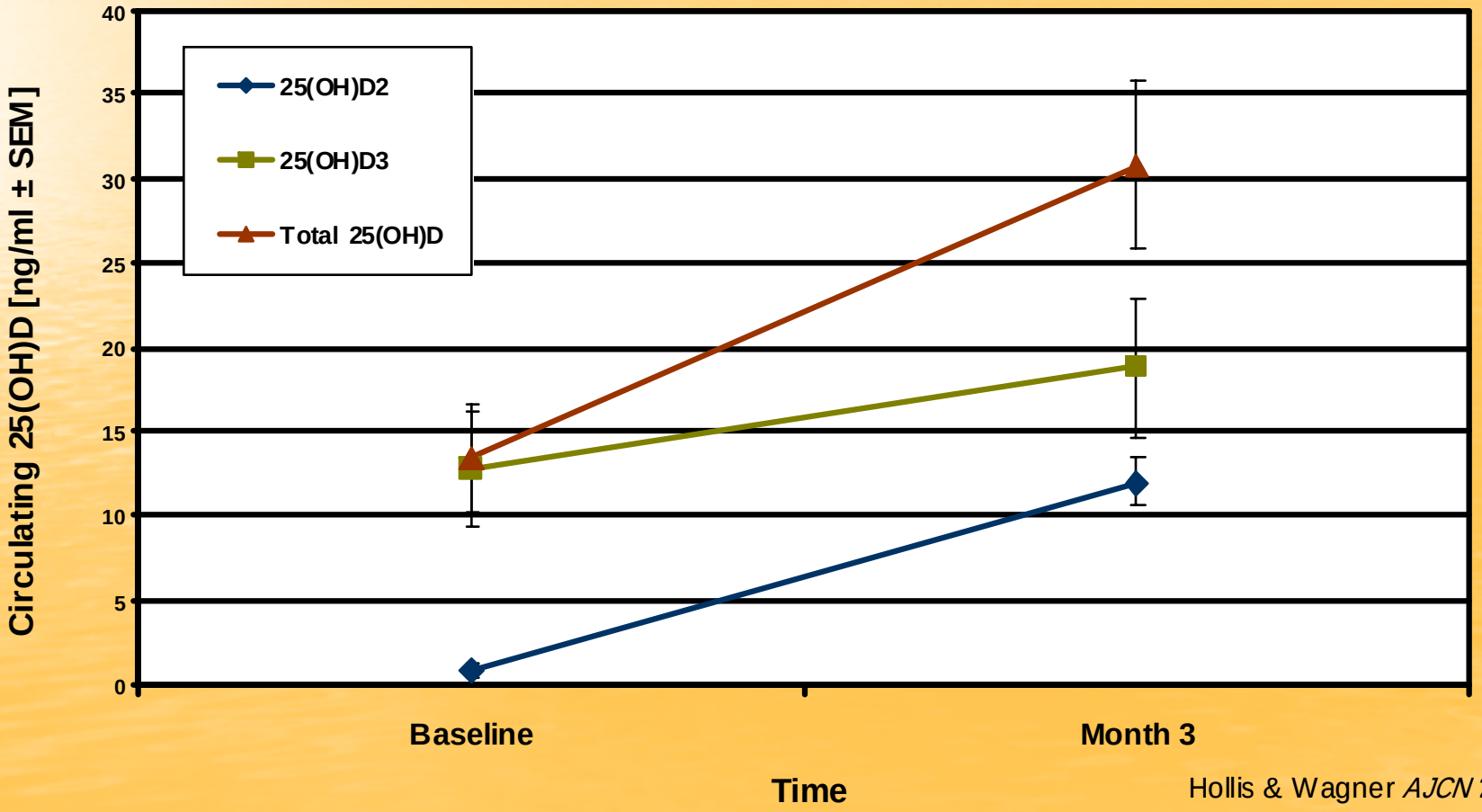
Hollis & Wagner *AJCN* 2004

Infant circulating 25(OH)D concentrations over 3 months with maternal supplementation of 1600 IU/d vitamin D_2 and 400 IU/d vitamin D_3



Hollis & Wagner *AJCN* 2004

Infant circulating 25(OH)D concentrations over 3 months with maternal supplementation of 3600 IU/d vitamin D_2 and 400 IU/d vitamin D_3



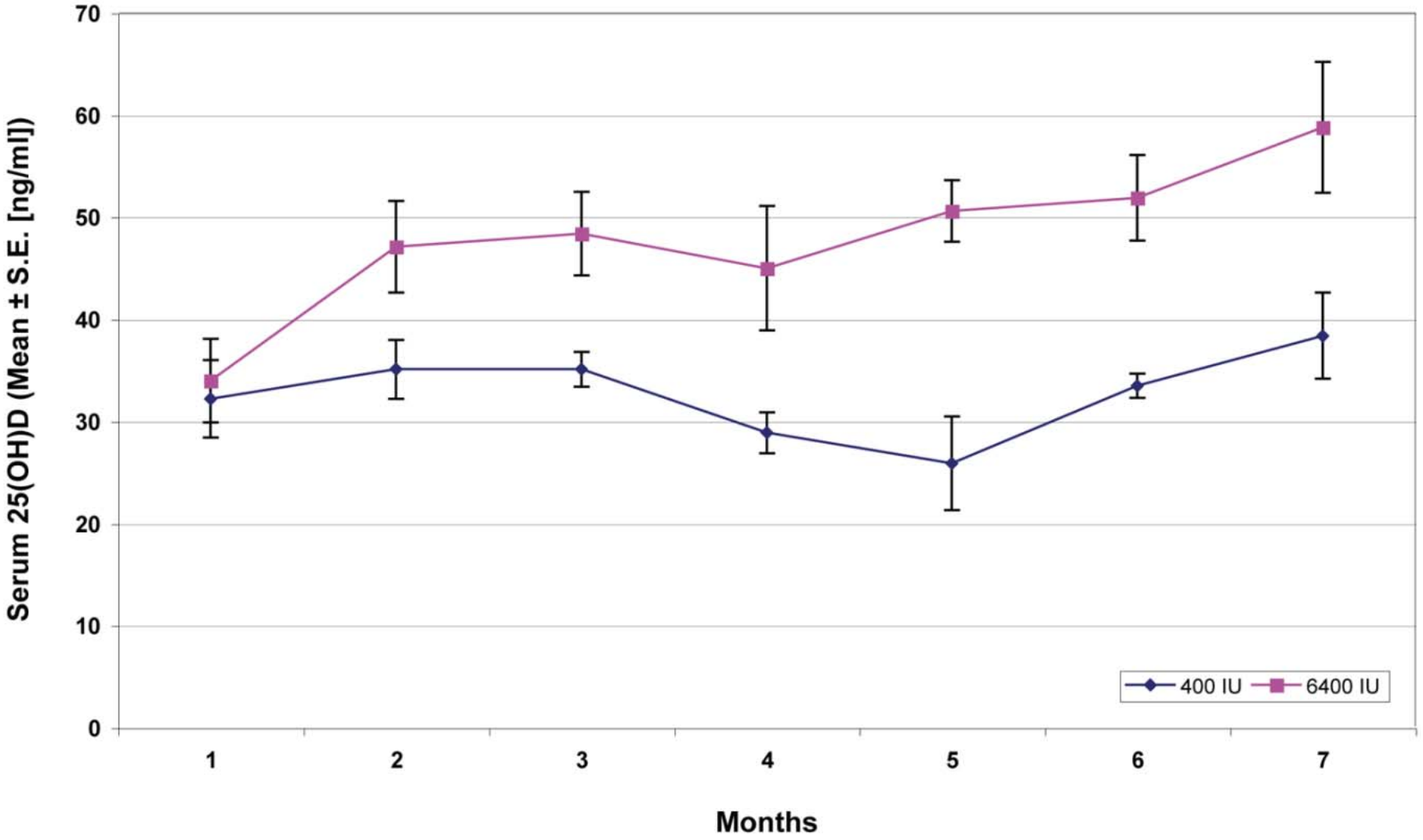
Hollis & Wagner *AJCN* 2004

Comparison of Maternal and Infant Vitamin D Supplementation

- For 6 months

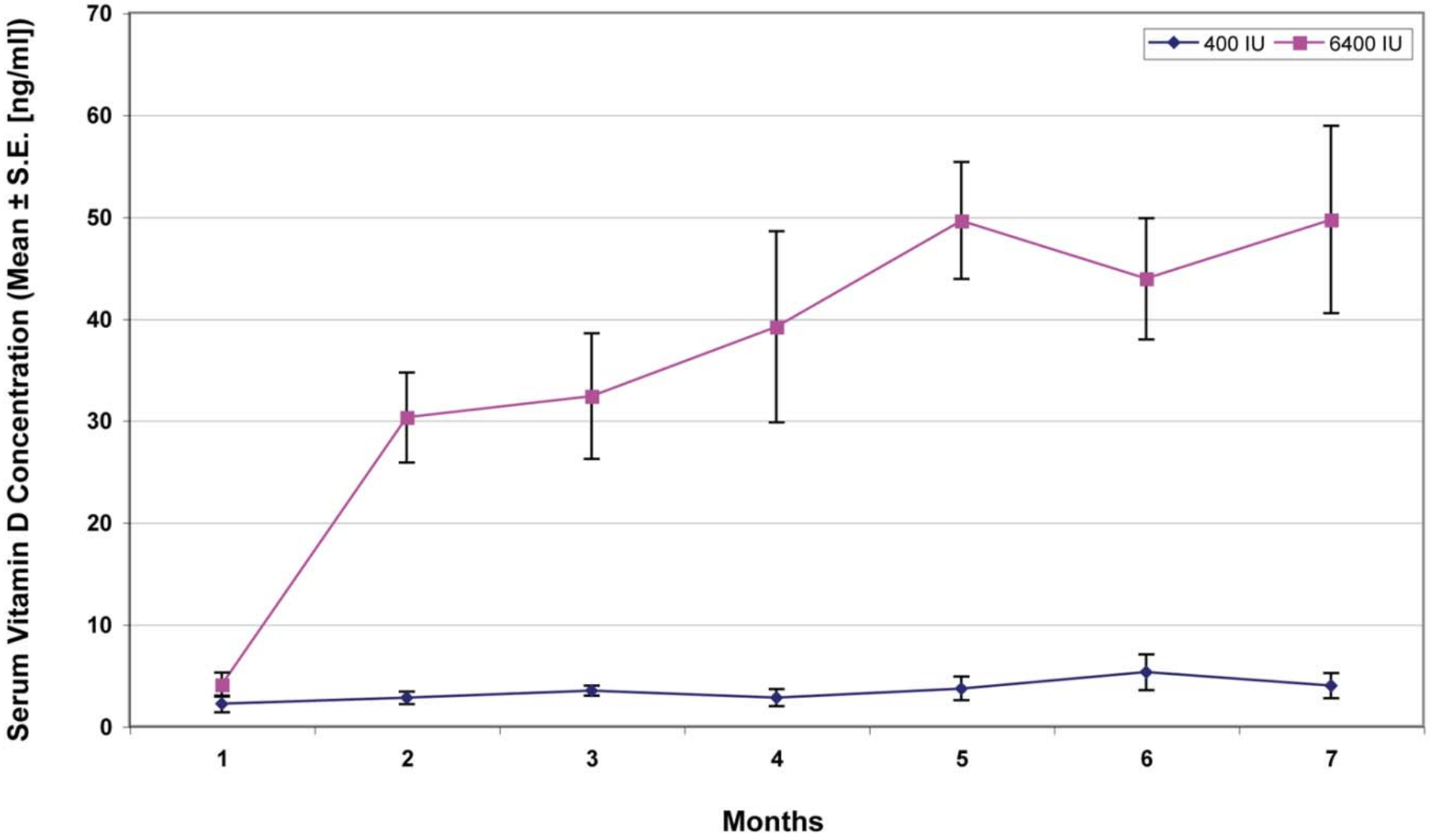
- 10 women received 400 IU/day vitamin D_3 and infant received 300 IU/day vitamin D_3
- 9 women received 6400 IU/day vitamin D_3 and infant received placebo

Figure 3. Maternal Serum 25(OH)D Concentration Achieved with Supplementation with 400 versus 6,400 IU/day



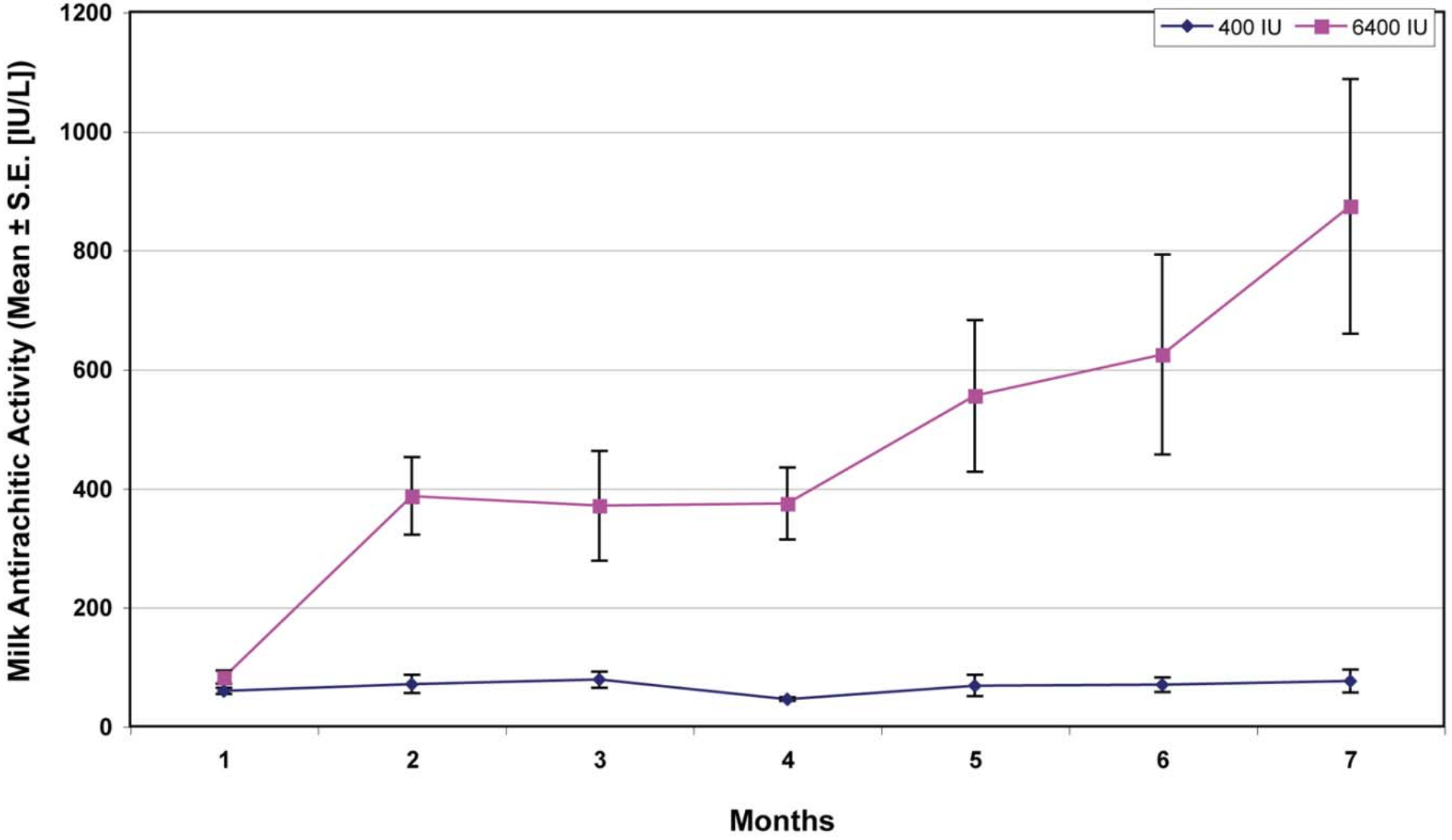
From Taylor et al, *ARN* 2008 with data from Wagner et al, Breastfeeding Med 2006

Figure 4. Maternal Serum Vitamin D Concentration Achieved with Supplementation with 400 versus 6,400 IU/day



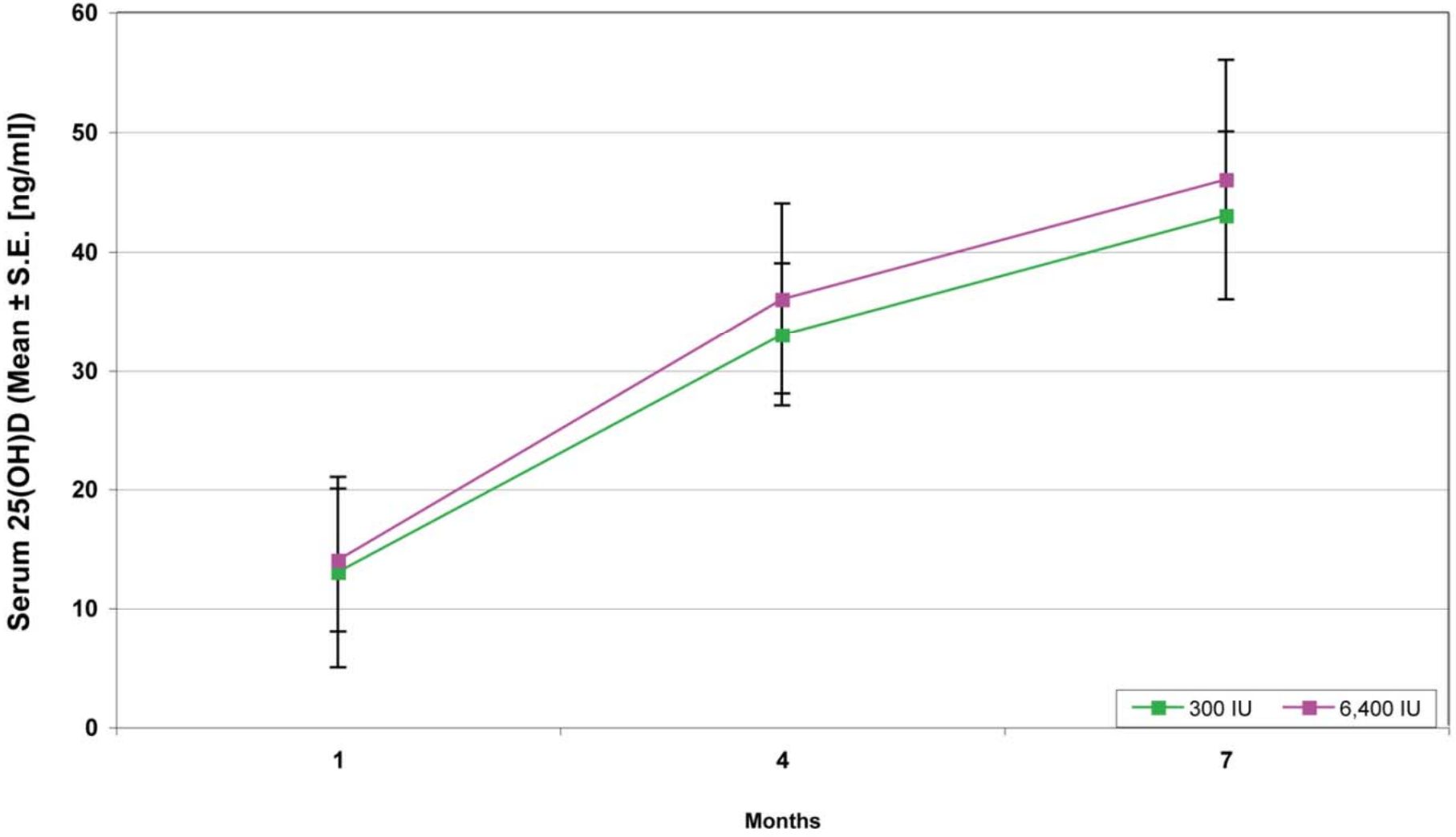
From Taylor et al, *ARN* 2008 with data from Wagner et al, Breastfeeding Med 2006

Figure 1. Milk Antirachitic Activity Achieved with Maternal Supplementation with 400 versus 6,400 IU/day



From Taylor et al, *ARN* 2008 with data from Wagner et al, Breastfeeding Med 2006

Figure 2. Infant Serum 25(OH)D Concentration Achieved with Maternal Supplementation with 6,400 IU/day versus Infant Supplementation with 300 IU/day



From Taylor et al, *ARN* 2008 with data from Wagner et al, Breastfeeding Med 2006

Safety

- Serum calcium concentrations remained normal
- No hypercalciuria observed

Conclusion

- In our study, 82% of women begin pregnancy with vitamin D insufficiency and 38% with vitamin D deficiency

- Vitamin D supplementation of mother can provide adequate breast milk vitamin D to achieve vitamin D sufficiency in the nursing infant

Canadian Paediatric Society Recommendations 2007

"Consideration should be given to administering 2000 IU of vitamin D daily to pregnant and lactating women, especially during the winter months, to maintain vitamin D sufficiency. The effectiveness of this regimen and possible side effects should be checked with periodic assays for 25(OH)D and calcium."

First Nations, Inuit and Métis Health Committee, Canadian Paediatric Society (CPS), *Paediatrics & Child Health* 2007.