

**GrassrootsHealth's North Dakota D*Action
Project Preliminary Update:
Serum 25(OH)D Concentrations Among Child-Bearing Age
Women in North Dakota Require A
Public Health Call To Action**

Beth S. Sanford, DNP, RN, ACN, CLC, PHN



MY INSPIRATION



**RECENTLY
PUBLISHED DATA
DEMONSTRATES
AN URGENT NEED
FOR PRENATAL
INTERVENTION IN
NORTH DAKOTA**

1. In 2023, the March of Dimes published a report on perinatal outcomes by state where ND scored a **C-** on preterm birth.
2. The report also noted maternal mortality to be **higher** in ND (24.2 per 100,000) than the national rate of 23.5 per 100,000
3. In addition, in 2021, 2102 births in ND (**22%**) were funded by state Medicaid putting a significant burden on taxpayers for potentially avoidable prenatal complications (KFF, 2021).

VITAMIN D IS

- a hormone
- a vitamin/nutrient
- a cell-signaling molecule

Functions include

- Communicating between cells
- Regulating of the immune system
- Preventing tumor growth
- Regulating gene expression
- Decreasing inflammation
- Insulin regulation
- Maintaining endothelial integrity
- And so much more...

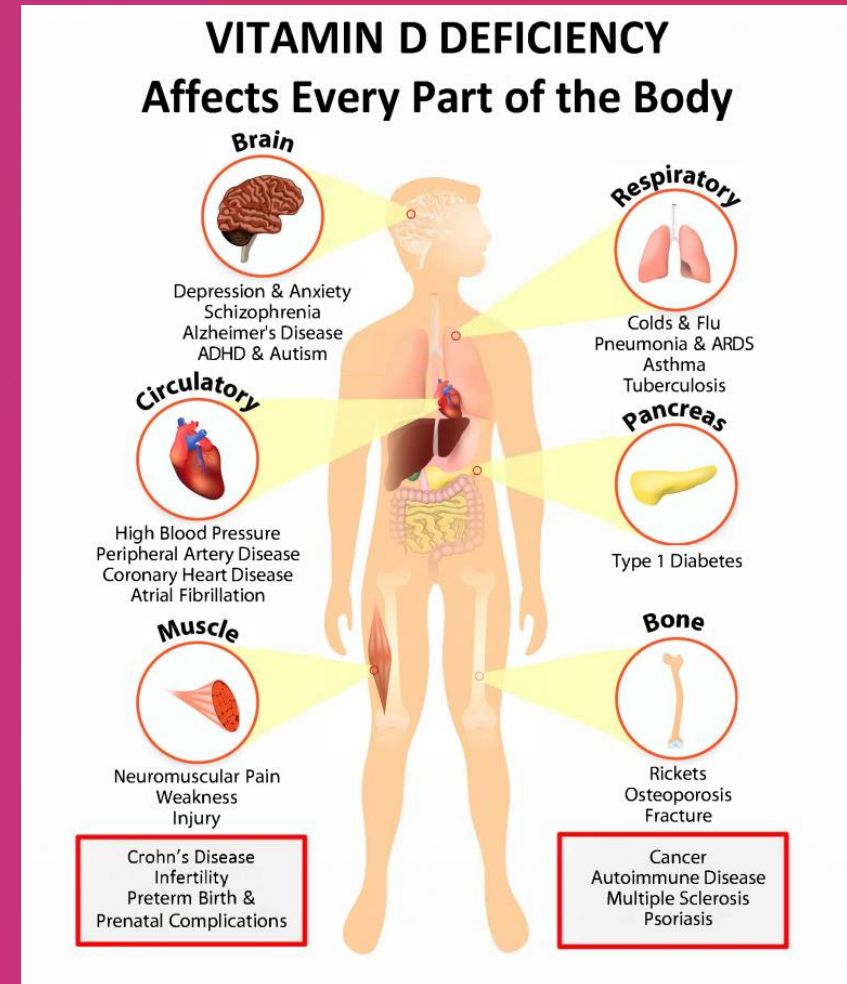
“Vitamin D has multiple overlapping mechanisms developed evolutionarily and designed to protect humans from internal (metabolic and oxidative abnormalities) and external (environmental and pathogens) harm. Its canonical actions work via **modulating and repairing genomic DNA.**

However, vitamin D also has critical non-genomic activities, like acting on membranes and intracrine/autocrine and paracrine signaling mechanisms. These non-transcriptional mechanisms are essential in **controlling inflammation, preventing endothelial and epithelial cell destabilization, and keeping humans healthy.**”

~ *Dr. Sunil Wimalawansa*

HOW VITAMIN D IMPACTS THE BODY

[INTERACTIVE PDF: HOW VITAMIN D DEFICIENCY AFFECTS EVERY PART OF THE BODY - GRASSROOTSHEALTH](#)



KEY CONCEPT: UNIQUE CHANGES HAPPEN TO VITAMIN D METABOLISM DURING PREGNANCY

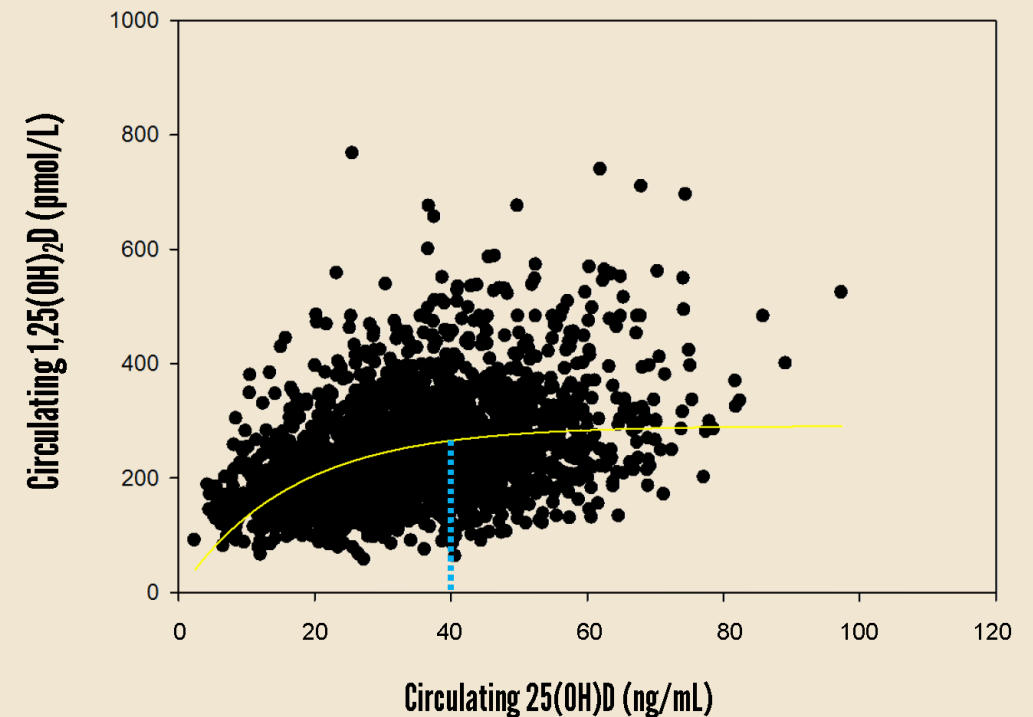
Pregnancy may be the most important time during the lifecycle that adequate vitamin D status should be ensured



CHANGES IN VITAMIN D METABOLISM DURING PREGNANCY

- During pregnancy, conversion of 25(OH)D to the hormonal form, 1,25(OH)₂D, increases so that by 12 weeks, levels in the blood are triple that of normal, non-pregnant female and normal male subjects. In a non-pregnant person, these levels would alter calcium concentrations in the blood and result in toxicity and potential death, but these are perfectly normal levels during pregnancy.
- The rise in 1,25(OH)₂D is independent of the calcium system, nor is it controlled by parathyroid hormone, which is the only time in the lifecycle that this un-coupling occurs.
- Further observation has revealed that the direct influence of 25(OH)D (up to ~40 ng/ml) on 1,25(OH)₂D levels is also unique to pregnant women.
- The chart illustrates the conversion of 25(OH)D to 1,25(OH)₂D observed during pregnancy. The inflection point, where conversion switches from first order to zero order kinetics, can be seen at 40 ng/ml (100 nmol/L). This is the point at which conversion of 25(OH)D into 1,25(OH)₂D becomes independent of 25(OH)D concentration and 1,25(OH)₂D production is optimized, indicating a specific need for serum levels of at least 40 ng/ml in pregnant women.

Relationship of Circulating 25(OH)D on Circulating 1,25(OH)₂D During Pregnancy



$$1,25(\text{OH})_2\text{D} = 291.231 * (1 - \exp(-0.0242509 * 25(\text{OH})\text{D}))$$

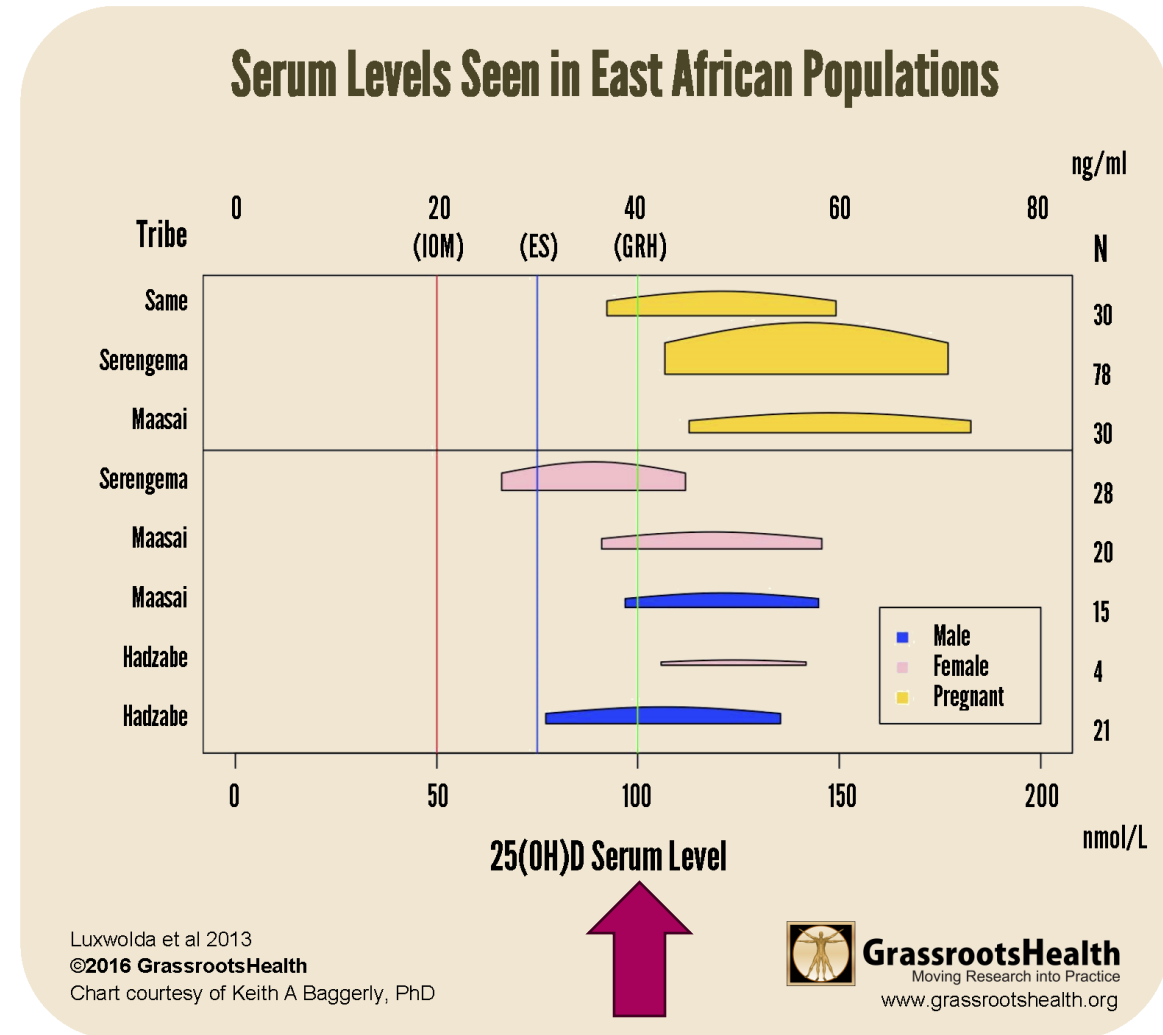
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Courtesy of CL Wagner



GrassrootsHealth
Moving Research into Practice
www.grassrootshealth.net

WHAT HAPPENS WHEN VITAMIN D3 IS PLENTIFUL IN PREGNANCY?

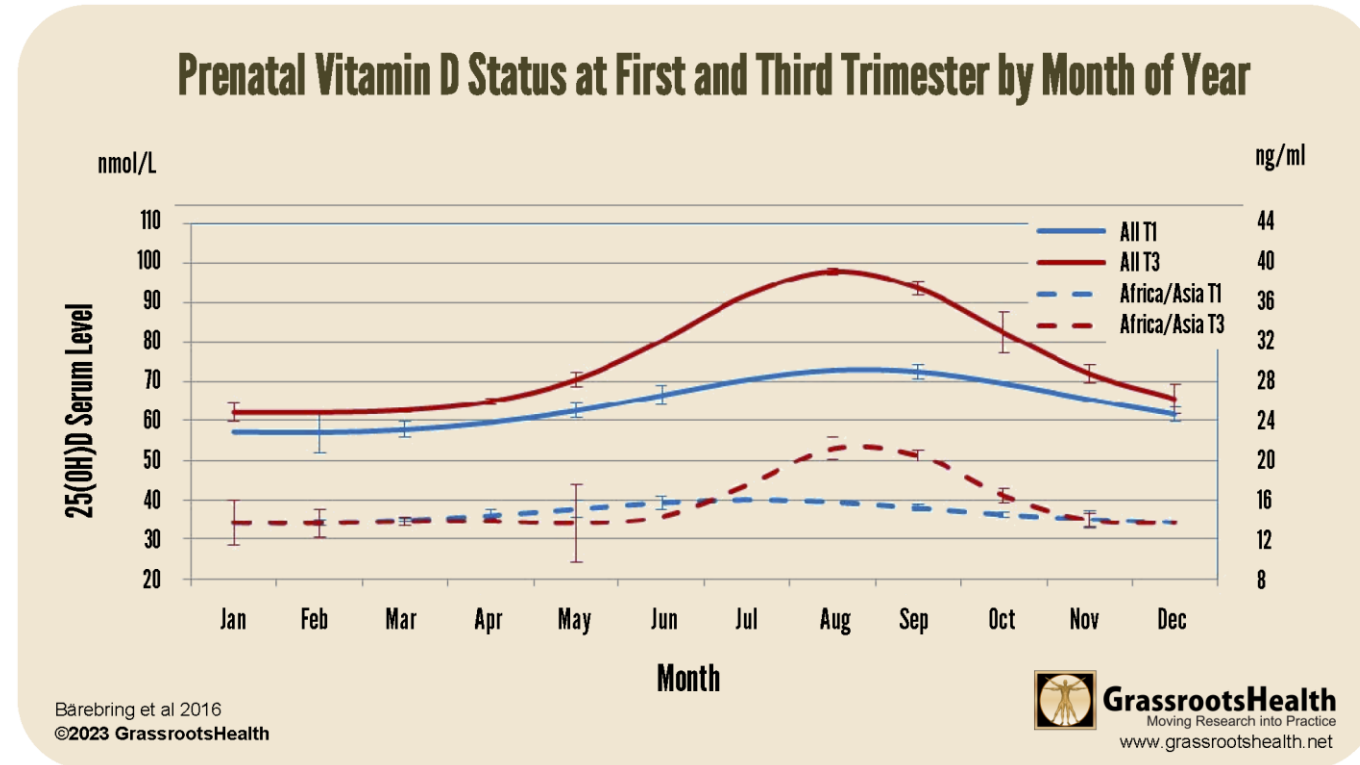
- The study investigated the vitamin D status across the life cycle in various East African populations to determine what serum 25(OH)D level represents sufficient status among populations whose lifestyle closely matches that of our ancestors.
- The average serum 25(OH)D level of this population as a whole is at least 40 ng/ml. The chart below illustrates the levels Luxwolda found in these African tribes, which are much higher than what is currently accepted by the National Academy of Sciences (previously the IOM) and most medical institutions (and are very close to GrassrootsHealth's recommended 40-60 ng/ml).
- Further, 25(OH)D levels in pregnancy (shown in yellow) are far higher than in non-pregnant individuals, indicating the higher vitamin D need for the mother during pregnancy.



WHAT HAPPENS WHEN VITAMIN D3 IS LACKING?

What is Meant to Happen CAN'T Without Enough Vitamin D

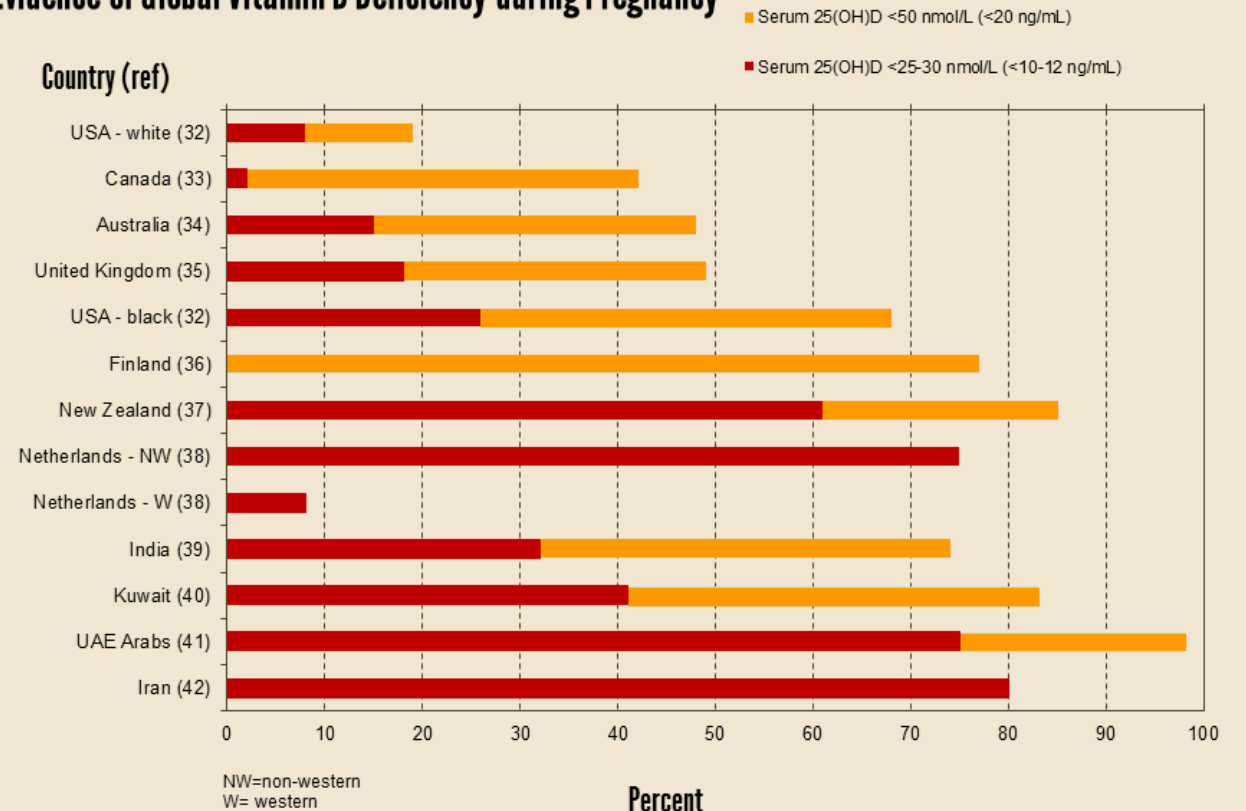
- A study by Bärebring et al. measured the vitamin D status of pregnant women in Sweden during their first (T1) and third (T3) trimesters and compared T1 and T3 vitamin D status by month of year. Two blood samples were collected from each participant - T1 before 17 weeks gestation, and T3 after 31 weeks gestation.
- The chart from this study, seen below, illustrates that the rise in 25(OH) vitamin D concentrations, especially during the third trimester of pregnancy, peaked in the summer months, when vitamin D3 from sunshine was more plentiful. Also, the rise was more pronounced in T3 than T1, indicating increased conversion and a greater need for vitamin D towards the end of pregnancy.
- This chart clearly shows how 25(OH)D was limited during the non-summer months, especially in the third trimester, when vitamin D3 was less available to the women.
- These differences raise the question – if the women in this study had more availability to vitamin D3 throughout the seasons of their pregnancy (such as through supplementation), especially in the third trimester, would seasonal variability in vitamin D levels have been as great, or would all pregnant woman have experienced peak T3 serum levels?
- Another important finding from this study was that the resulting 25(OH) vitamin D levels confirmed the high prevalence of deficiency among pregnant women; 10% of all, 51% of women born in Africa, and 46% of women born in Asia were severely deficient (<12 ng/ml or <30 nmol/L). How are these low levels of vitamin D affecting their resulting 1,25(OH)2D levels, which we previously showed is meant to increase substantially in pregnancy? How is this lack of prenatal vitamin D3 affecting the health of the pregnancy and baby?



VITAMIN D DEFICIENCY IS COMMON AMONG PREGNANT WOMEN

- Unfortunately, vitamin D deficiency among pregnant women is common world-wide. The chart below displays the incidence of vitamin D deficiency (below 20 ng/ml) and severe vitamin D deficiency (less than 10-12 ng/ml) in pregnant women world-wide.
- Countries most affected include the United Arab Emirates, Iran, the Netherlands (NW) and New Zealand.

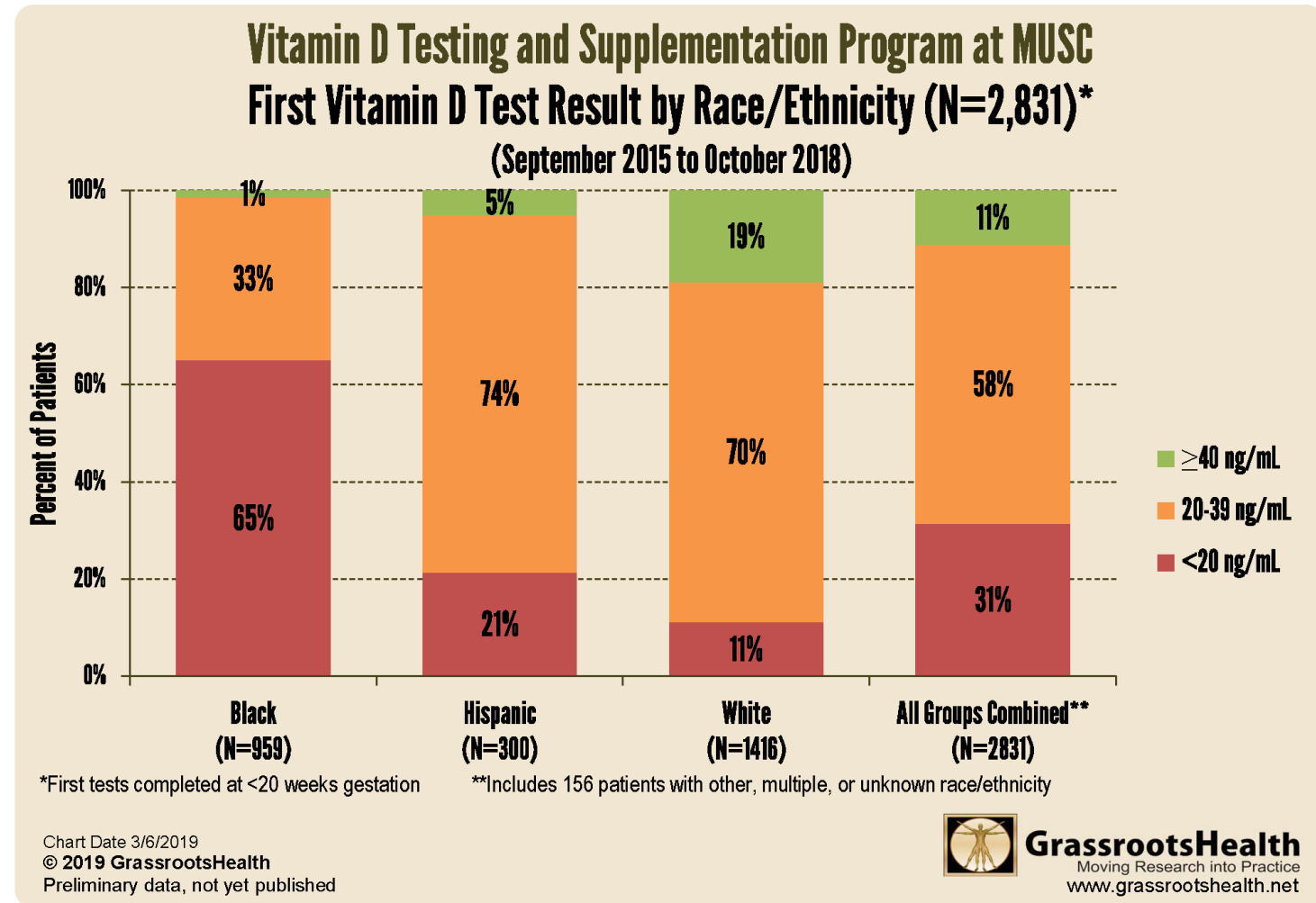
Evidence of Global Vitamin D Deficiency during Pregnancy



* Slide courtesy of Adekunle Dawodu. From: Dawodu and Wagner, Annals of Tropical Child Health, Feb 2012

VITAMIN D DEFICIENCY IS COMMON AMONG PREGNANT WOMEN

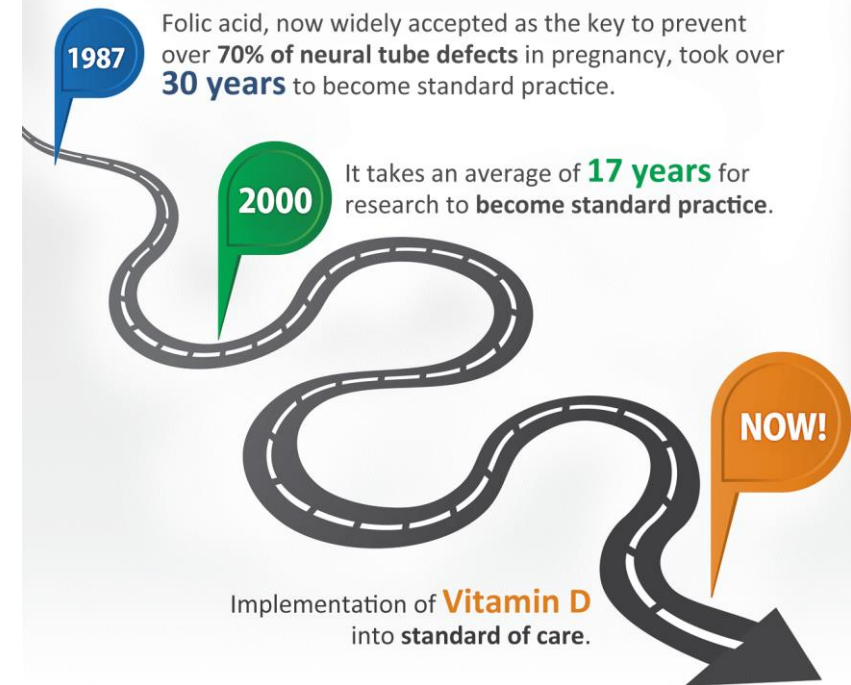
- The Medical University of South Carolina (MUSC) implemented routine vitamin D testing for all pregnant patients as part of a project in collaboration with GrassrootsHealth. MUSC Health is a comprehensive, urban medical center treating a large, diverse population of women.
- A vast majority of prenatal patients (89%) had vitamin D levels less than 40 ng/ml on their first vitamin D test and almost one-third (31%) had vitamin D levels less than 20 ng/ml. Black women had particularly low vitamin D levels; almost all (99%) were less than 40 ng/ml and approximately two-thirds (65%) were less than 20 ng/ml. These vitamin D levels are representative of prenatal vitamin D levels across the United States.



INTRODUCTION: PRENATAL VITAMIN D RESEARCH FINDINGS

- Since 2000, significant progress has been made in understanding the physiological impact of VDD/I on prenatal health and maternal outcomes.
- Nearly twenty years of research have noted circulating 25(OH)D concentrations prior to conception, during the prenatal and postpartum periods of ≥ 40 ng/ml are considered “critical” for optimal maternal outcomes, with safely administered doses up to and exceeding 4,400 IU/day without adverse events (Wagner et al., 2017; McDonnell et al., 2017; Hollis & Wagner, 2022; Grant et al., 2023).

Moving Vitamin D Research into Practice





2006

Pregnancy and Vitamin D

Researchers question current vitamin D requirement for pregnant women and indicate a **higher daily dose is safe and necessary.**

2011

1st Study in S. Carolina

RCT shows **4000 IU/day is safe and effective** in raising vitamin D levels in pregnant women.

2013

2nd Study in S. Carolina

Study on larger population found similar results – **4,000 IU/day safe and effective.** Also found relationship between **vitamin D and preterm birth.**

2015

New Standard of Care

Medical University of South Carolina tests every pregnant patient with the goal of raising vitamin D levels to **40 ng/ml.**

2016

Lower Risk of Preterm Birth

Study shows **decrease in preterm birth** rates with Vitamin D levels up to 40 ng/ml.

NOW Results are In!

60% Lower Preterm Birth Risk for those with **Vitamin D levels over 40 ng/ml.**

Achieving and maintaining minimum serum 25(OH)D concentrations of ≥ 40 ng/ml are needed to support fertility, placental health, breast health, uterine health, and genetic expression in pregnancy.



GrassrootsHealth
Moving Research into Practice

SYSTEMATIC REVIEW

Recent systematic reviews found VDD/I in pregnancy is a modifiable risk factor for morbidities such as:

- hypertensive disorders,
- preeclampsia,
- preterm birth,
- gestational diabetes,
- pulmonary embolism,
- uterine atony,
- post-partum hemorrhage,
- low birth weight, and
- risk for maternal mortality

(Suarez-Varela, et al., 2022a &b)

RANDOMIZED CONTROLLED TRIALS

- A recently published randomized controlled trial by Amiri et al. (2023) found a 60% reduction in cesarean section, 93% reduction in pre-eclampsia, and 96% reduction in preterm birth in women with levels of 20 ng/mL or higher vs. women with severe VDD of less than 10 ng/ml. The study also found significantly higher rates of gestational diabetes, low birth weight, and other pregnancy complications.
- Another recently published randomized controlled trial in the Democratic Republic of Congo found a significant reduction in preeclampsia, preterm birth, low birth weight, c-section, as well as higher apgar scores and newborn size in the supplemented group (Kabuyanga et al., 2024).
*single monthly dose (60,000 IU) of vitamin D supplementation

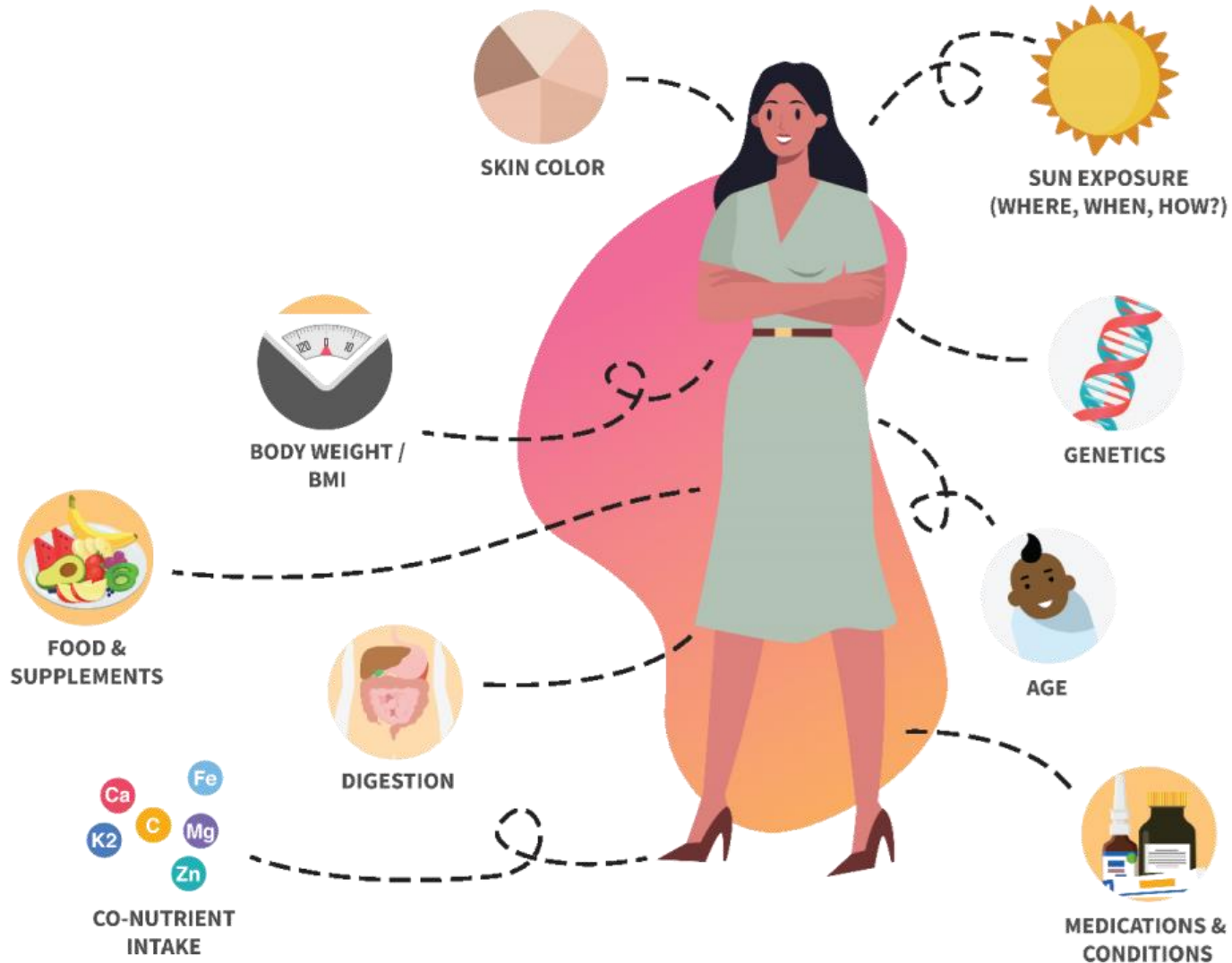
OBSERVATIONAL STUDIES

- In a 2017 study (N=1,064), researchers found optimizing vitamin D levels to ≥ 40 ng/ml prior to birth vs. < 20 ng/ml improved preterm birth risk among both white women and non-white women, with 65% ($p=0.03$) and 68% ($p=0.008$) lower risk, respectively (McDonnell et al., 2017).
- The most notable improvement in the study was among non-white women whose initial vitamin D levels were < 40 ng/ml who raised their level to ≥ 40 ng/mL—their preterm birth rate was 78% lower than those who did not raise their level.
- *Of the non-white women enrolled in the study, 69% were B/AA women.



DETERMINANTS OF HEALTH

- Environmental determinants of health pose a significant risk for vitamin D deficiency and insufficiency in North Dakota (ND) such as latitude (48 degrees N), where vitamin D-generating ultraviolet B (UVB) rays do not reach the state from October to April due to solar zenith, and inclement weather drives the population indoors (Sanford et. al, 2023).



INDIVIDUAL RISK FACTORS

- Medication use, age, co-nutrient intake, digestive health, body weight, occupation, lifestyle choices, skin color, and cultural habits, leading to decreased sun exposure during peak UV index hours (10-2 pm) or covering of the body for personal or religious reasons may be additional individual risk factors for healthcare providers to consider (Sanford et al., 2023).

BLACK/AA WOMEN AT INCREASED RISK FOR HEALTH DISPARITIES R/T VDD/I

- B/AA women are at increased risk for health disparities related to VDD vs. their Caucasian counterparts due to darker skin tone, requiring increased time in the sun to manufacture similar amounts of vitamin D (Ames et al., 2021; Englesen, 2010).
- NHANES Data show 68% of Black/AA women have vitamin D concentrations <20 ng/ml, with 80% of Black/AA having vitamin D Levels below 30 ng/ml (75 nmol/L); 95% below the scientific recommendation of 40 ng/ml (100 nmol/L) (GrassrootsHealth, 2022)



The Fitzpatrick Scale



THE NORTH DAKOTA VITAMIN D*ACTION PROJECT

FOUNDED IN 2021 A COLLABORATION WITH
GRASSROOTSHEALTH NUTRIENT INSTITUTE

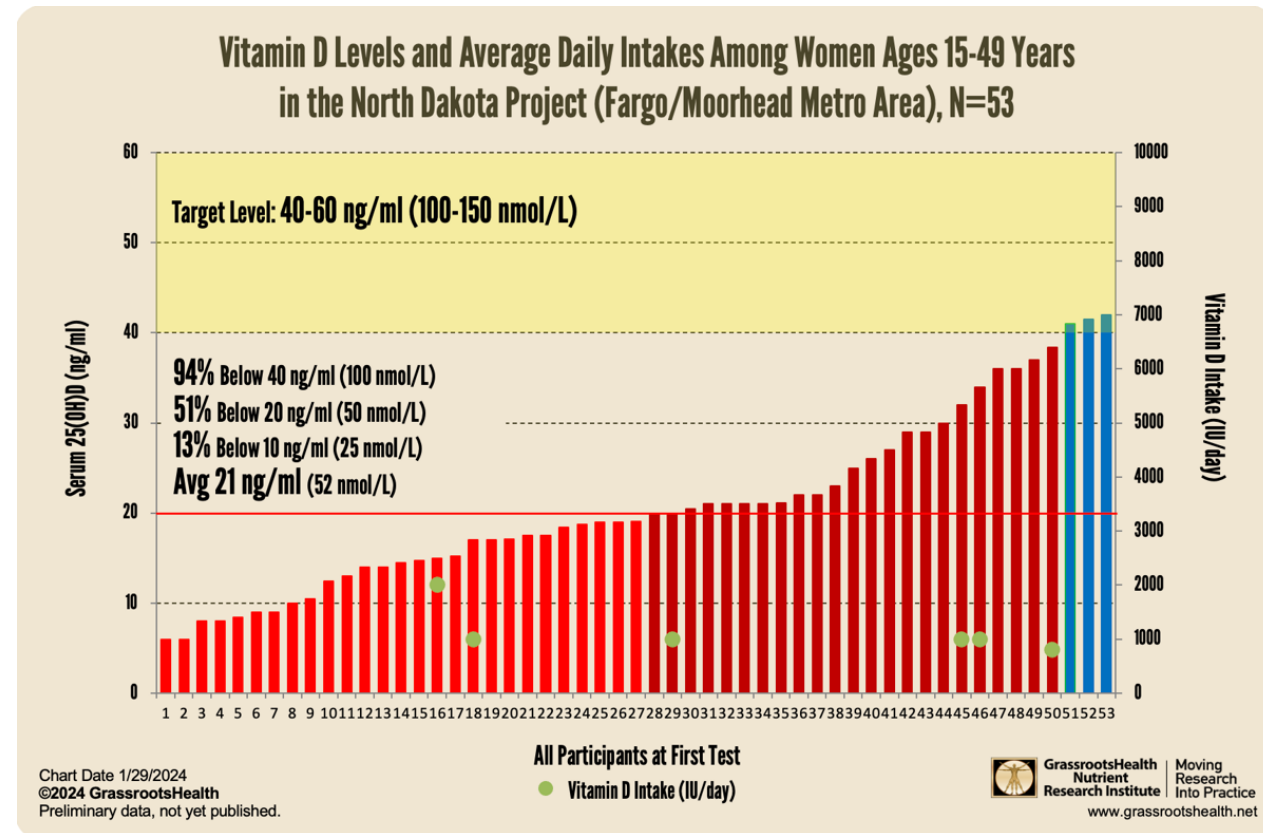


METHODS

Utilizing preliminary data gathered through the GrassrootsHealth Nutrient Research Institute's North Dakota Vitamin D*action Project, which measured 25(OH)D serum concentrations from a total of 80 participants, 53 women of childbearing age and their serum levels were identified and sorted by ethnicity (Caucasian, non-Caucasian, and a subgroup of Black/African American women).

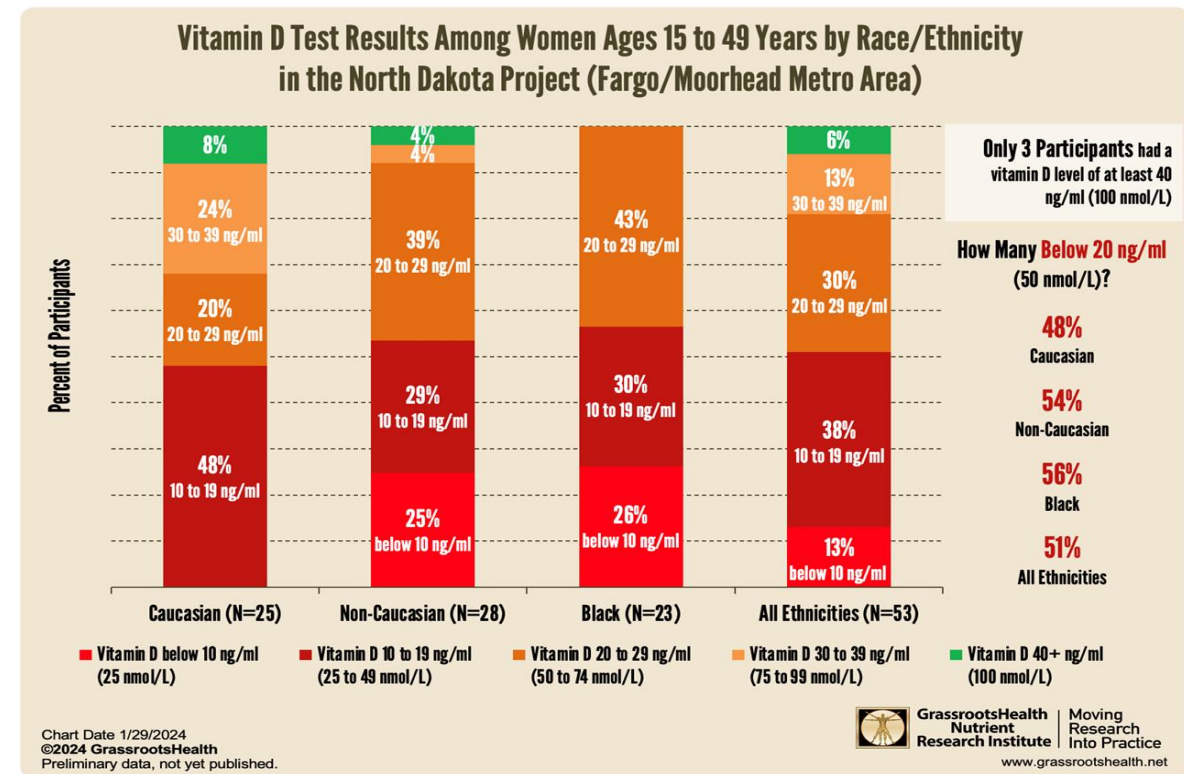
VITAMIN D LEVELS AND AVERAGE DAILY INTAKES AMONG WOMEN AGES 15-49Y IN THE NORTH DAKOTA PROJECT (N=53)

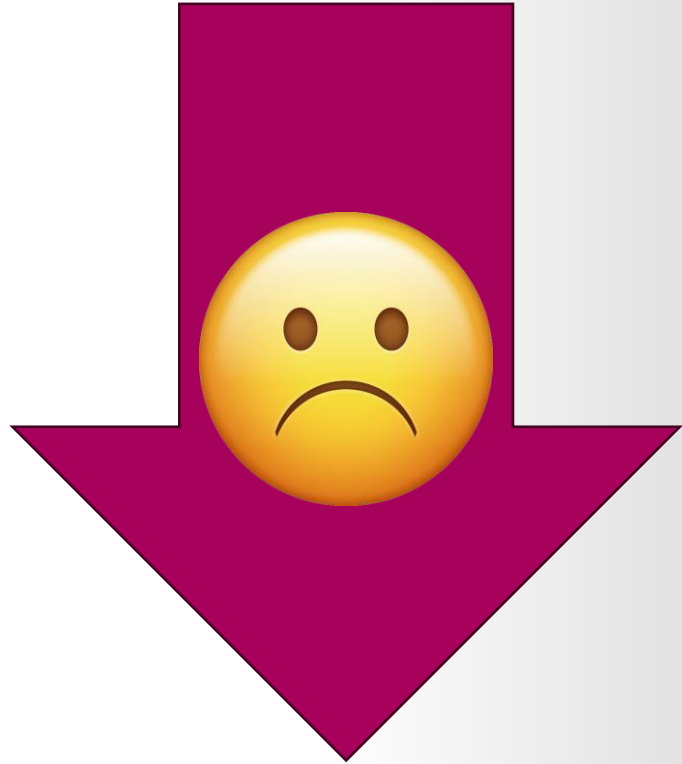
- Preliminary results showed that half of all women (51%) had a vitamin D level below 20 ng/ml and one quarter (25%) of non-Caucasian women had levels below 10 ng/ml, indicating an immense need for vitamin D interventions among this population. Only three women in total had a level of at least 40 ng/ml.



VITAMIN D TEST RESULTS AMONG WOMEN AGES 15-49 YEARS OLD BY RACE/ETHNICITY IN THE NORTH DAKOTA PROJECT (N=53)

- Caucasian women (n=25) had higher 25(OH)D serum concentrations overall with 8% (n=2) having a level of at least 40 ng/mL, 24% were between 30-39 ng/mL, 20% 20-29 ng/mL, and 48% 10-19ng/mL.
- Among non-Caucasian women (n=28), 4% (n=1) had a level of at least 40 ng/mL, 4% were between 30-39 ng/mL, 39% 20-29 ng/mL, 29% 10-19ng/mL, and 25% were below 10 ng/mL.
- Black/AA women had the lowest 25(OH)D serum concentrations, with 43% between 20-29 ng/mL, 30% 10-19ng/mL, and 26% below 10 ng/mL; none of the Black women in this group had a 25(OH)D concentration of 30 ng/ml or above.





WHAT DO THESE RESULTS MEAN?

North Dakota moms and babies, even more so non-Caucasian women, are at increased risk of maternal morbidity and mortality related to vitamin D deficiency and insufficiency.

Addressing Vitamin D Deficiency and Insufficiency in Pregnancy is Low Hanging Fruit



RECOMMENDATIONS

Cultural
Competency
Education to Reduce
Disparities

Higher Education
Initiatives

Continuing
Education for
Licensed Healthcare
Professionals

Community-Based
Educational
Initiatives for all,
especially at-risk
populations

Institutional
Initiatives

Healthcare Policy
Initiatives

Educating providers on how regional DOH and individual risk factors may impact vitamin D status, as well as skin-tone-specific safe sun exposure recommendations, may assist to eliminate preventable VDD/I in all women, reducing health disparities among non-Caucasian pregnant women.

(Ames et al., 2021; Sanford et al., 2023).



CULTURAL COMPETENCY EDUCATION

HIGHER EDUCATION INITIATIVES

- Integrating current vitamin D science, properly designed research, and best practices throughout the curriculum, research initiatives, and practical experiences (Heaney, 2014; Sanford et al., 2023).
- New American Nurses catch the vision!
 - Somali
 - Nigerian
 - Kurdish
 - Liberian
- A Florida nurse catches the vision! Amanda Alexander, MSN, RN
- [Vitamin D, "Are we current in our evidence-based practice?" \(Guest Blog\) - GrassrootsHealth](#)
- Edwina O. Opara, BSN, RN Labor & Delivery Nurse in Washington, D.C.



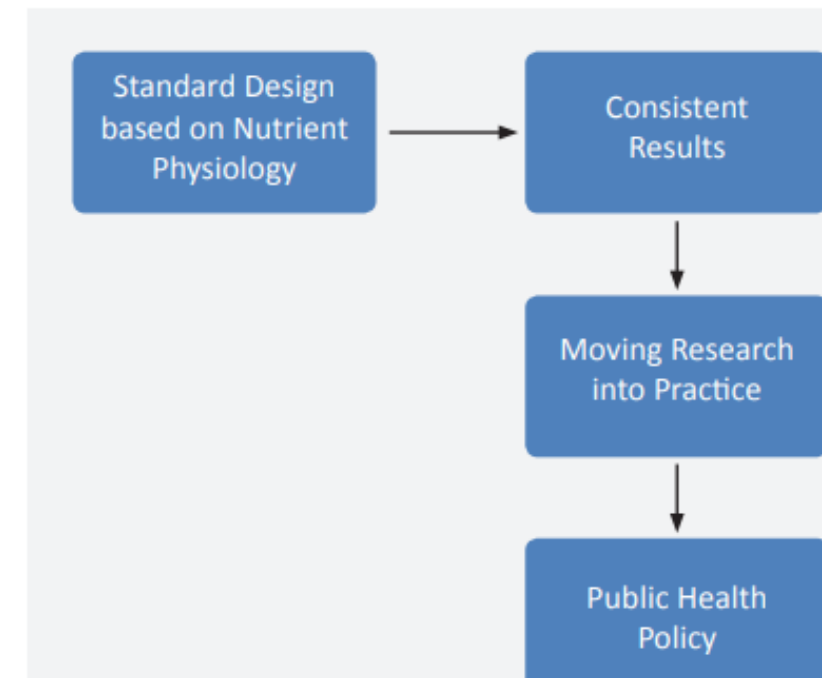
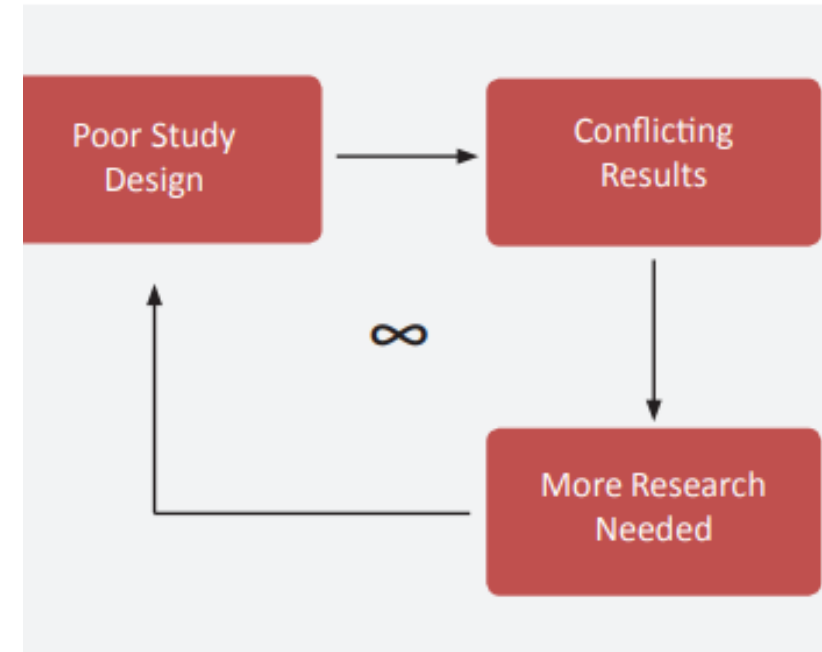


COMMUNITY-BASED EDUCATIONAL INITIATIVES

- Leveraging key community stakeholders, focused education initiatives in workplaces, community centers, community organizations, & places of worship as well as social media to disseminate information.

INSTITUTIONAL INITIATIVES

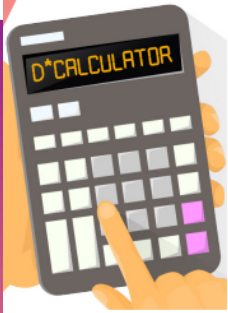
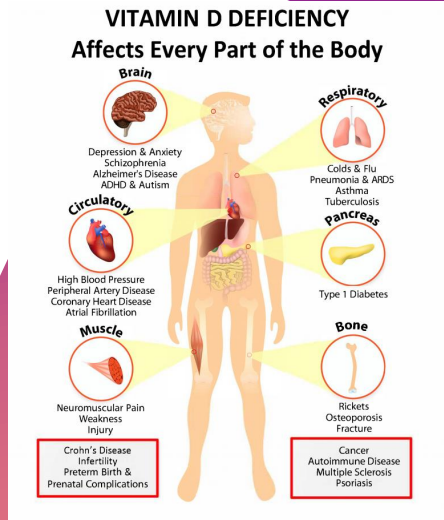
- Prenatal screening and treatment programs have been found effective in the early detection and treatment of VDD/I in women, demonstrating improved maternal outcomes (Kabuyanga et al., 2024; McDonnell et al., 2017; Rostami et al., 2023; Wagner et al., 2016).
- Since the mid-2000s, researchers at the Medical University of South Carolina in collaboration with GrassrootsHealth Nutrient Institute, have had success improving prenatal outcomes among urban women using an evidence-based protocol, a three-step testing method testing serum 25(OH)D concentrations at 3 timepoints during pregnancy: baseline, 1st trimester (<16 weeks); 2nd trimester (16–26 weeks); and 3rd trimester (≥27 weeks) and preterm birth), focusing on achieving and maintaining circulating 25(OH)D concentrations of ≥40 ng/ml. Women were also given free bottles of 5000 IU of vitamin D3 (Wagner et al., 2017)
- Incorporating continuing education and e-tools as well as decision-making processes such as order-set, properly designed research & quality improvement initiatives using the Heaney criteria of nutrient design (pre- and post-intervention blood work targeting optimal 25(OH)D concentrations of 40-60 ng/ml), and change champions (Heaney, 2014; Sanford et al., 2023; Uko & Utley, 2020).



HEALTHCARE POLICY INITIATIVES

- Initiatives should focus on local or regional determinants of health and utilize a primary prevention model for addressing VDD/I in prenatal health.
- Recommendations include public education campaigns, increasing funding for vitamin D screening & testing three times during pregnancy in government programs for low-income women, decreasing overall testing costs as well as intentional continuing education efforts provided by professional organizations.
- In 2013, Alaska passed a concurrent resolution to address vitamin D deficiency from a primary prevention standpoint.





D*Calculator

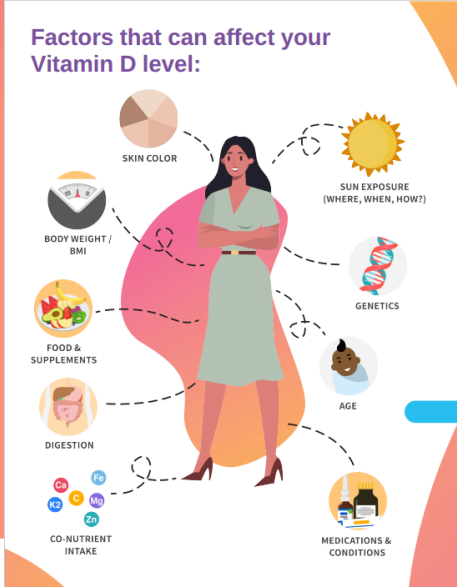
To further individualize vitamin D dosing options, use the vitamin D*calculator at grassrootshhealth.net/dcalculator, which offers a more accurate calculation based on weight, starting vitamin D level, and preferred target vitamin D level.



DISSEMINATE RESEARCH & BEST PRACTICE RESOURCES HOME - GRASSROOTSHEALTH

Moving Vitamin D Research into Practice: Addressing Vitamin D Deficiency to Improve Patient Outcomes, Population Health & Reduce Costs

Did you know that 75% of the world is estimated to be vitamin D deficient? This educational course aims to get the latest vitamin D public health science and best practice protocols, direct from world-renowned vitamin D researchers, into the hands of healthcare professionals and individuals... moving research into practice to impact patient outcomes and population health, and potentially reducing healthcare costs across the globe.



KNOW "D" NUMBER

Patient and Provider Guide to Understanding Vitamin D, Testing & Results

GrassrootsHealth Nutrient Research Institute
Moving Research Into Practice

YOUR VITAMIN D LEVEL
40



CONCLUSION

- The results of the study implicate the need for a public health call to action for all women of childbearing age in North Dakota, with additional emphasis on at-risk populations residing in the state such as ethnic minorities and women in poverty.
- Priority should be given to establishing state-wide health care policy, institutional research and quality improvement programs tracking patient and financial outcomes, community-based outreach programs, evidence-based screening programs, and prenatal care protocols, as well as healthcare professional, patient, and family education on the importance of achieving and maintaining optimal serum 25(OH)D concentrations of at least 40-60 ng/mL through supplementation and safe sun exposure.
- Implementation of these interventions is expected to improve state perinatal outcomes.



YOUR VITAMIN D
LEVEL

40
ng/ml



NEXT STEPS

- Create policies and procedures related to three-step prenatal vitamin D testing and repletion for your facility
- Create a Quality Improvement project with facility-specific metrics, i.e., (maternal and neonatal outcomes) using the Heaney criteria for nutrient study design (pre-post 25(OH)D serum concentrations, vitamin D*calculator for individual weight-specific recommendations)
- Create a staff education and testing event, offer discounted testing services and education
- Disseminate the findings of your QI project at a local or national conference and/or write an article for publication
- Gather interdisciplinary professionals for a Northern Plains vitamin D conference (Vitamin D Prenatal track?)
- Potential concurrent resolution at the next legislative session
- *What does great look like? If you aren't sure, ask! I'd love to help 😊*



ONWARD TO BETTER HEALTH FOR ALL NORTH DAKOTANS!

- Beth Sanford, DNP, RN
- 701-200-4544
- ND.bethsanford@gmail.com

