Background: Vitamin D is a fat-soluble vitamin needed for promoting calcium absorption in the gut and ultimately enabling normal bone mineralization. It is also needed for bone growth and remodeling and has more recently been discovered to be involved in other physiologic processes, including modulation of neuromuscular and immune function, as well as reduction of inflammation. It may also play a role in modulating cancer cell proliferation. The growing evidence that vitamin D may help prevent several chronic diseases prompts the need to identify individuals at risk for vitamin D deficiency.Humans get vitamin D from their diet, in dietary supplements, and from exposure to sunlight. People living at higher latitudes have been shown to have lower levels of serum vitamin D compared with those living in lower latitudes, and levels of serum vitamin D are highest during the summer months when sun exposure is greater. Examination of the relationship between serum vitamin D levels and obesity is done using logistic regression analysis, with vitamin D deficiency as the binomial outcome and obesity as the binomial primary explanatory variable. Other important covariates we have adjusted for in our analyses thus far (using publicly accessible NHANES data) include: age, sex, race/ethnicity, poverty status, and the use of vitamin D-containing supplements. Because exposure to sunlight is also an important factor to account for when measuring serum vitamin D levels, we want to adjust for latitude of residence and month/season of lab draw, in addition to the other mentioned covariates. These variables are only available through the RDC.

Merge Variables: SEQN will be used to merge the public and restricted data files.

Unit or Level of Analysis and Subpopulation(s): Unit of Analysis – individual
Subpopulation – Children 6-18, excluding pregnant females, those with implausible BMIs, and those with missing covariate data.

Analysis Plan: We have already performed logistic regression analyses using SAS-callable SUDAAN on the public use NHANES data for 2003–2006. The outcome is serum vitamin D level and is dichotomized into "deficient" (<15ng/ml or the 10^{th} percentile) or "not deficient" (≥ 15ng/ml). The primary explanatory variable is obesity (or BMI ≥ 95^{th} percentile for age) and is categorized as yes or no. The remaining covariates include:

- age (as a continuous variable, in years, for one analysis),
- age group (categorized into 6–9 years, 10–12 years, 13–15 years, and 16–18 years, for a separate analysis),
- sex (male or female),
- race/ethnicity (categorized as Non-Hispanic white, Non-Hispanic black, Mexican American, and other races, including multiracial),
- poverty status (categorized as <2.0 PIR or ≥ 2.0 PIR), and
- vitamin D-containing supplement use (yes or no),

- latitude of residence (North vs South);
- season of MEC lab draw (Winter, Spring, Summer, Fall).

Complex Survey Design: Our codes account for weighting and a complex sample design, where WTMEC4YR = 1/2 x WTMEC2YR for this 4-year sample. Example logistic regression code follows:

```
proc rlogist data = out.vitdobese_4 filetype=sas design=wr;
nest sdmvstra sdmvpsu/missunit;
weight wtmec4yr;
subpopn include = 1/name="6-18 year olds, no pregnant females";
class obese sex raceth fampir vitdsup/nofreqs;
reflevel obese=0 sex=1 raceth=1 fampir=2 vitdsup=2;
model vitd10 = obese sex raceth fampir vitdsup examageyr;
etc.
```

Public Health Benefit: Our study seeks to examine the relationship between serum vitamin D levels, measured as 25- hydroxyvitamin D and dichotomized as vitamin D deficient or not, and obesity, defined as a BMI ≥ 95th percentile for age, in children aged 6–18 years. Prior research in adolescents and adults has shown a positive association between

vitamin D deficiency and obesity. By establishing an association between low serum vitamin D levels and obesity in children across a wider age range, we aim to identify an easy- to-obtain and objective measure with which to target children who may be at greater risk for vitamin D deficiency. Using this measure, children deficient in vitamin D may be more readily identified and started on supplementation to correct it. Because vitamin D may be involved in improving other health measures or preventing other chronic diseases or conditions, treating deficiency may have benefits that extend beyond improved bone health.