Chapter 5:
Anemia & chronic kidney disease
Figure 5.1
Percent distribution of KEEP & NHANES participants with anemia, by CKD stage

Anemia Definitions
WHO
Males: hemoglobin <13g/dl
Females: hemoglobin < 12g/dl
K/DOQI
Hemoglobin<11g/dl

CKD Stages
Stage 1: eGFR ≥ 90, microalbuminuria +
Stage 2: eGFR 60–89, microalbuminuria +
Stage 3: eGFR 30–59
Stage 4: eGFR 1–29
Stage 5: eGFR <15 or patient on dialysis

KEEP N=1,792, NHANES III N=454, NHANES 1999–2000 N=106. Excludes participants with missing values for hemoglobin.
Figure 5.2
Anemia (WHO & K/DOQI anemia definitions) in KEEP & NHANES participants, by age

Anemia Definitions
WHO
Males: hemoglobin < 13 g/dl
Females: hemoglobin < 12 g/dl
K/DOQI
Males: hemoglobin < 12 g/dl
Women & age > 50: < 12 g/dl
Women & age ≤ 50: < 11 g/dl


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Figure 5.3
Anemia (WHO & K/DOQI anemia definitions) in KEEP & NHANES participants, by race/ethnicity

KEEP N=21,804, NHANES III N=16,795. Excludes participants with missing values for hemoglobin or race.
Figure 5.4
Anemia (WHO & K/DOQI anemia definitions) in KEEP & NHANES participants, by CKD status

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Anemia Definitions
WHO
Males: hemoglobin <13g/dl
Females: hemoglobin < 12g/dl
K/DOQI
Males: hemoglobin<12g/dl
Women & age >50: <12 g/dl
Women & age ≤50: <11g/dl

**Figure 5.5**

Anemia (WHO & K/DOQI anemia definitions) in KEEP & NHANES participants, by gender & CKD status

**Anemia Definitions**

**WHO**
- Males: hemoglobin <13g/dl
- Females: hemoglobin <12g/dl

**K/DOQI**
- Males: hemoglobin <12g/dl
- Women & age >50: <12 g/dl
- Women & age ≤50: <11g/dl

**KEEP N=22,342, NHANES III N=15,670, NHANES 1999–2000 N=4,565. Excludes participants with missing values for hemoglobin or CKD status.**

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Figure 5.6
Anemia (WHO & K/DOQI anemia definitions) in KEEP & NHANES participants, by race & CKD status

**Anemia Definitions**
WHO
Males: hemoglobin <13g/dl
Females: hemoglobin < 12g/dl
K/DOQI
Males: hemoglobin<12g/dl
Women & age >50: <12 g/dl
Women & age ≤50: <11g/dl

KEEP N=21,673,
NHANES III N=15,670.
Excludes participants with missing values for hemoglobin, CKD status, or race.
Figure 5.7
Anemia (WHO & K/DOQI anemia definitions) in KEEP & NHANES participants, by CKD stage & self-reported diabetic status

**Anemia Definitions**
- **WHO**
  - Males: hemoglobin <13g/dl
  - Females: hemoglobin <12g/dl
- **K/DOQI**
  - Males: hemoglobin <12g/dl
  - Women & age >50: <12g/dl
  - Women & age ≤50: <11g/dl

**CKD Stages**
- Stage 1: eGFR ≥90, microalbuminuria +
- Stage 2: eGFR 60–89, microalbuminuria +
- Stage 3: eGFR 30–59
- Stage 4: eGFR 1–29
- Stage 5: eGFR <15 or patient on dialysis

**KEEP N=22,076, NHANES III N=15,654, NHANES 1999–2000 N=4,562.** Excludes participants with missing values for hemoglobin, CKD status, or self-reported diabetes.
Figure 5.8
Anemia (WHO & K/DOQI anemia definitions) in KEEP & NHANES participants, by CKD stage & gender

Figure 5.9
Anemia (WHO & K/DOQI anemia definitions) in KEEP & NHANES participants, by CKD stage & race/ethnicity

KEEP N=21,673, NHANES III N=15,670. Excludes participants with missing values for hemoglobin, CKD status, or race. **Sample size less than 30.

**CKD Stages**
Stage 1: eGFR ≥ 90, microalbuminuria +
Stage 2: eGFR 60–89, microalbuminuria +
Stage 3: eGFR 30–59
Stage 4: eGFR 1–29
Stage 5: eGFR <15 or patient on dialysis

**Anemia Definitions**
WHO
Males: hemoglobin <13g/dl
Females: hemoglobin <12g/dl
K/DOQI
Males: hemoglobin<12g/dl
Women & age >50: <12 g/dl
Women & age ≤50: <11g/dl
Figure 5.10
Influence of eGFR on anemia (WHO & K/DOQI anemia definitions) in KEEP & NHANES participants

KEEP N=19,986, NHANES III N=16,141. Excludes participants with missing values for hemoglobin, CKD status, race, self-reported diabetes or hypertension, or smoking status. Adjusted for age, gender, race, self-reported diabetes & hypertension, & smoking status.

Anemia Definitions
WHO
Males: hemoglobin <13g/dl
Females: hemoglobin < 12g/dl
K/DOQI
Males: hemoglobin<12g/dl
Women & age >50: <12 g/dl
Women & age ≤50: <11g/dl
Figure 5.11
Odds ratio of anemia (WHO & K/DOQI anemia definitions) in KEEP & NHANES participants, by age

Anemia Definitions
WHO
Males: hemoglobin <13g/dl
Females: hemoglobin <12g/dl
K/DOQI
Males: hemoglobin<12g/dl
Women & age >50: <12 g/dl
Women & age ≤50: <11g/dl

KEEP N=19,986, NHANES III N=16,141. Excludes participants with missing values for hemoglobin, CKD status, race, self-reported diabetes or hypertension, or smoking status. Adjusted for gender, race, self-reported diabetes & hypertension, smoking status, & eGFR.
Figure 5.12
Odds of anemia (WHO & K/DOQI anemia definitions) in KEEP & NHANES participants, by race & self-reported diabetic status

Anemia Definitions
WHO
Males: hemoglobin <13g/dl
Females: hemoglobin < 12g/dl
K/DOQI
Males: hemoglobin<12g/dl
Women & age >50: <12 g/dl
Women & age ≤50: <11g/dl

KEEP N=19,986, NHANES III N=16,141. Excludes participants with missing values for hemoglobin, CKD status, race, self-reported diabetes or hypertension, or smoking status. Adjusted for age, gender, self-reported hypertension, smoking status, & eGFR.
Table 5.a
Odds ratios of anemia (WHO & K/DOQI anemia definitions) in KEEP & NHANES III participants

Anemia Definitions
WHO
Males: hemoglobin <13g/dl
Females: hemoglobin < 12g/dl
K/DOQI
Males: hemoglobin<12g/dl
Women & age >50: <12 g/dl
Women & age ≤50: <11g/dl

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<th>KEEP</th>
<th>WHO Anemia</th>
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<th>K/DOQI Anemia</th>
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<td>Upper</td>
<td>P-value</td>
<td>OR</td>
<td>Low</td>
<td>Upper</td>
<td>P-value</td>
</tr>
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<td>1.199</td>
<td>0.995</td>
<td>1.444</td>
<td>0.0561</td>
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<td>0.198</td>
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<td>2.410</td>
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<td>0.387</td>
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<td>0.851</td>
<td>0.776</td>
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<td>Self-reported hypertension</td>
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<td>1.301</td>
<td>0.0012</td>
<td>1.178</td>
<td>1.065</td>
<td>1.303</td>
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<td>eGFR(MDRD) ≥90</td>
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<td>1.000</td>
<td>1.000</td>
<td></td>
<td>1.000</td>
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<tr>
<td>eGFR(MDRD)60-&lt;90</td>
<td>0.881</td>
<td>0.793</td>
<td>0.978</td>
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<td>0.850</td>
<td>0.762</td>
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<td>1.690</td>
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<td>DM/white</td>
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<td>1.611</td>
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KEEP N=19,986, 
NHANES III N=16,141. 
Excludes participants with missing values for hemoglobin, CKD status, race, self-reported diabetes or hypertension, or smoking status. 
Adjusted for age, gender, race, self-reported diabetes & hypertension, & smoking status.
Table 5.a (continued)
Odds ratios of anemia (WHO & K/DOQI anemia definitions) in KEEP & NHANES III participants

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<td>Upper</td>
<td>P-value</td>
<td>OR</td>
<td>Low</td>
<td>Upper</td>
<td>P-value</td>
<td></td>
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<tr>
<td>18-30</td>
<td>0.95</td>
<td>0.72</td>
<td>1.24</td>
<td>0.7004</td>
<td>0.32</td>
<td>0.2</td>
<td>0.51</td>
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<td>0.73</td>
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<td>1</td>
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<tr>
<td>61-75</td>
<td>1.3</td>
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<td>1.7</td>
<td>0.0536</td>
<td>1.61</td>
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<td>1</td>
<td>1</td>
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<tr>
<td>Male</td>
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<td>eGFR(MDRD) ≥90</td>
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<td>1</td>
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<td>eGFR(MDRD) 60-&lt;90</td>
<td>0.85</td>
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Anemia Definitions
WHO
Males: hemoglobin <13g/dl
Females: hemoglobin < 12g/dl
K/DOQI
Males: hemoglobin<12g/dl
Women & age >50: <12 g/dl
Women & age ≤50: <11g/dl

KEEP N=19,986,
NHANES III N=16,141.
Excludes participants with missing values for hemoglobin, CKD status, race, self-reported diabetes or hypertension, or smoking status.
Adjusted for age, gender, race, self-reported diabetes & hypertension, & smoking status.

KEEP Data Report, 2004
Figure 5.13
Mean C-reactive protein in NHANES participants, by CKD stage & anemia status (WHO & K/DOQI anemia definitions)

Anemia Definitions
WHO
Males: hemoglobin <13g/dl
Females: hemoglobin < 12g/dl
K/DOQI
Males: hemoglobin <12g/dl
Women & age >50: <12 g/dl
Women & age ≤50: <11g/dl

NHANES III N=2,443,
NHANES 1999–2000
N=730. **Sample size less than 30.
Figure 5.14
Mean C-reactive protein in NHANES participants, by CKD stage, gender, & anemia status (WHO & K/DOQI anemia definitions)


Anemia Definitions
- WHO: Males: hemoglobin <13g/dl, Females: hemoglobin <12g/dl.
- K/DOQI: Males: hemoglobin<12g/dl, Women & age >50: <12 g/dl, Women & age ≤50: <11g/dl