



“Eat Your Fruits and Vegetables and Don’t Get Malaria: Linkages between Agriculture, Nutrition and Health in Uganda

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Data from the Feed the
Future USAID Nutrition
Innovation Lab for Africa

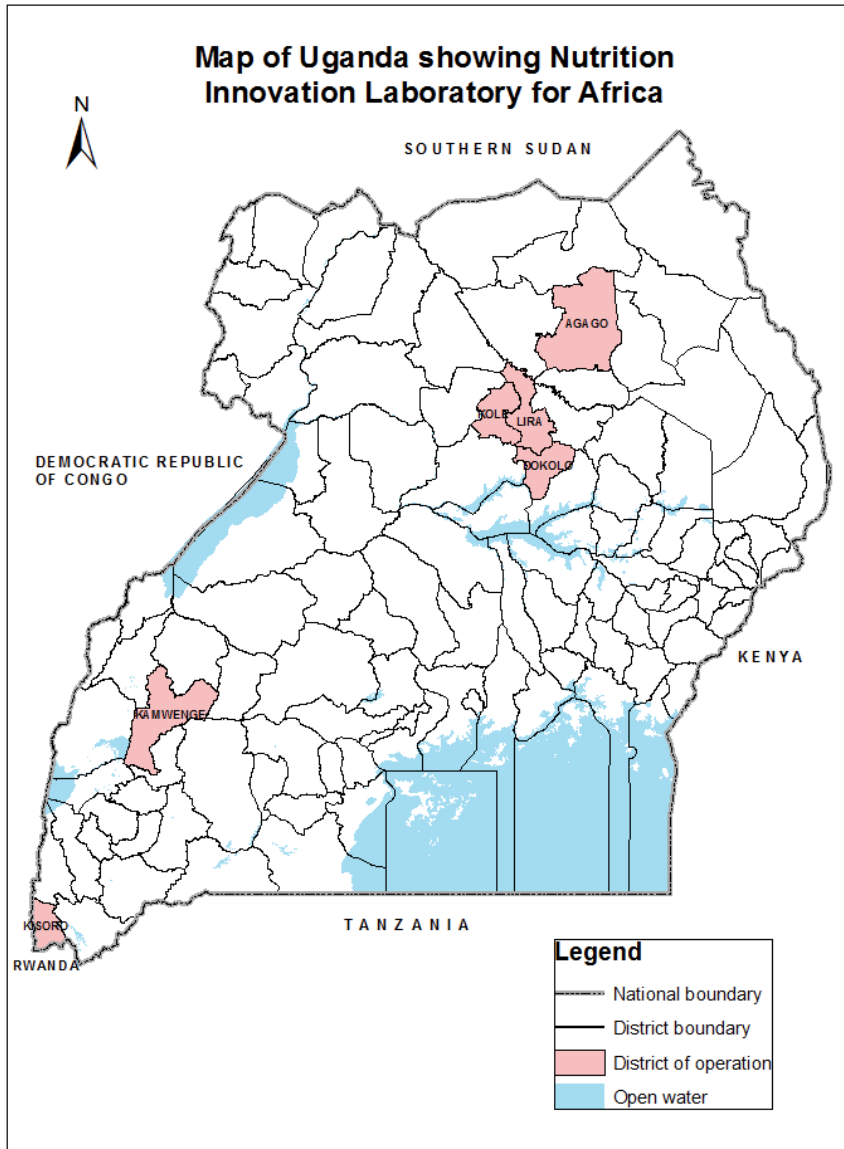
Background

- **Anemia** is a leading cause of death in pregnant women, and leads to much morbidity. It is a leading **nutrition indicator**. It is often due to a nutritional lack of **iron** and **vitamins**. **Affects growth and cognition in children.**
- **Fruits and vegetables contain vitamins, micro-nutrients needed to make erythrocytes. So do animal-source foods (iron, blood, etc).**
- **Malaria** leads to anemia through destruction of erythrocytes.

Agriculture → Nutrition

Fruit & Vegetable Production →
More F&V Consumption →
Less Anemia

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- Food/Nutrition programs to combat anemia widespread.
- Uganda may be most malarious country in the world – causes anemia.
- Classic health, public health, nutrition programs ignore one another.

Baseline Survey

Enumerate agricultural, livelihood, food security, nutritional, health, and gender outcomes in vulnerable households and populations

3,630 households in 6 districts

> 2,700 variables

~ 10 million bits of data

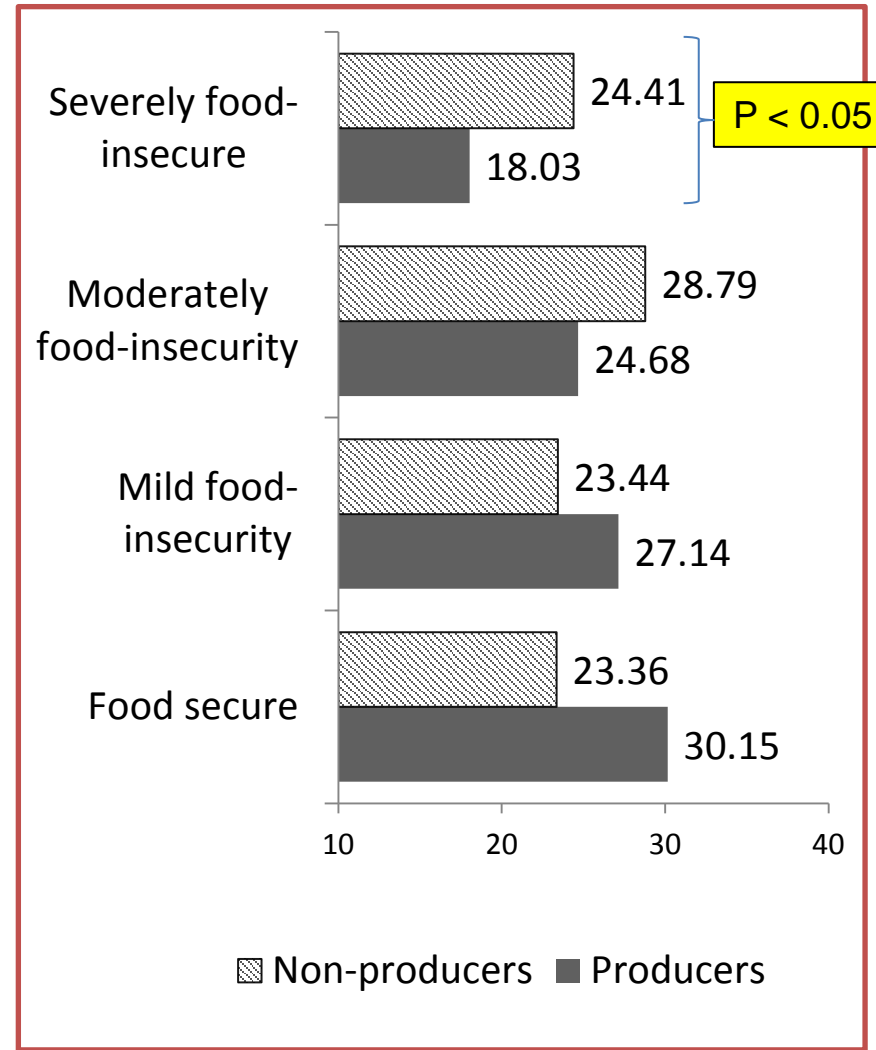
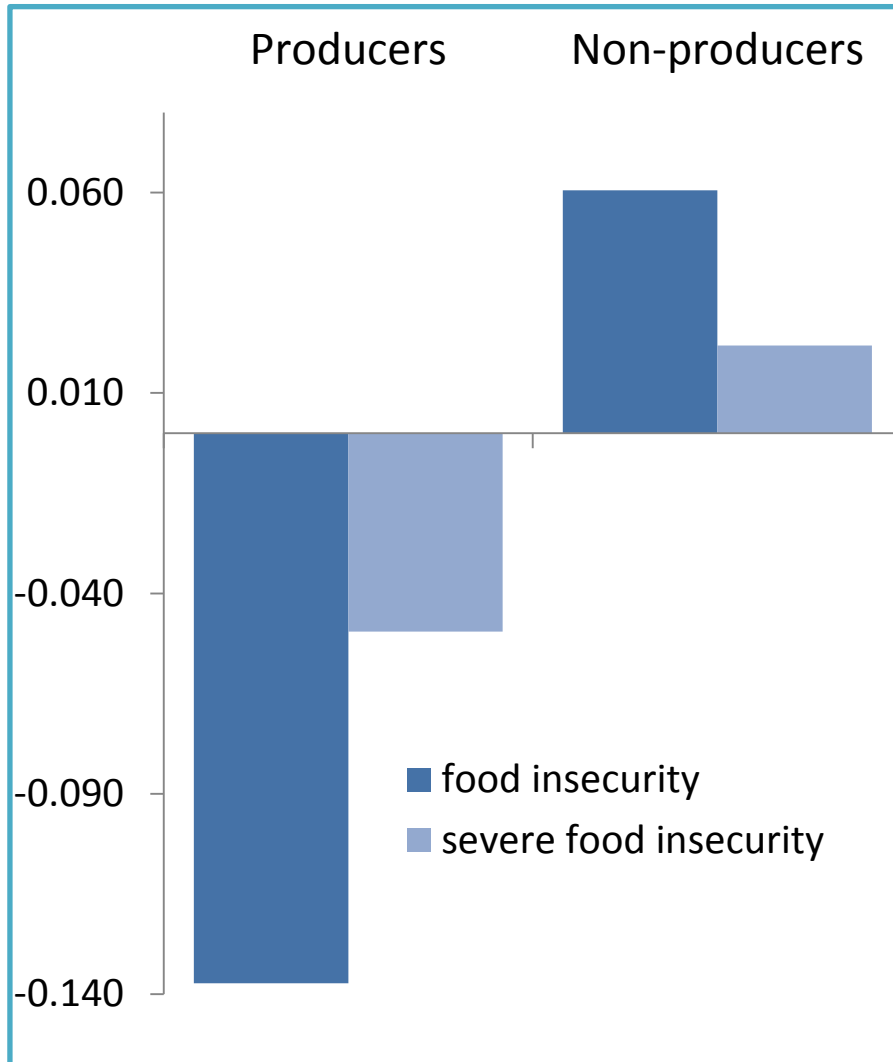
Measured hemoglobin and tested/treated malaria



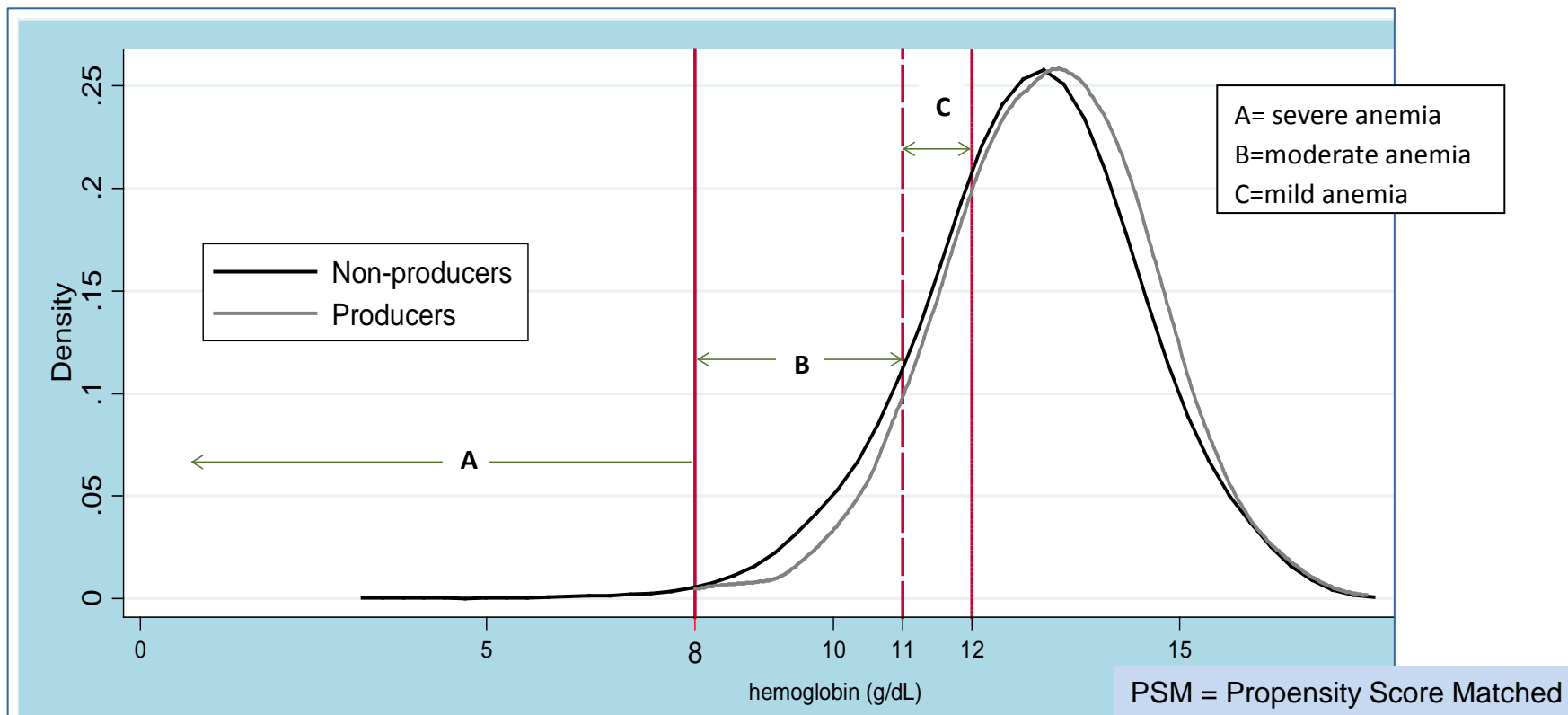
Fruit & Vegetable Production in Uganda Leads To: Improved Food Security, Less Anemia

- **F&V production significantly ↑ F&V consumption.** (76% vs 64%, $p < 0.01$). F&V producing households had less food insecurity, *especially* the most food insecure.
- **Women living in F&V households had higher Hgbs ($p < 0.01$) and were ~ 15% less likely to be anemic. No *severely* anemic women were found in F&V households, and *moderate* anemia was reduced by a quarter ($p < 0.01$ each). (controlled for malaria)**
- *This links F&V production, better food security, and less anemia.*

F&V Producers Have Less Food Insecurity



F&V production: effect on maternal anemia



	F&V Producers	Non-producers	Change (producers vs. non-producers)	t-value and significance
Hemoglobin (g/dL)	13.03	12.84	+ 0.19 g/dL	3.34, $p < 0.01$
Maternal anemia (%)	21.37%	25.47%	- 16.1%	-2.65, $p < 0.01$
Mat. anemia, PSM	20.97%	24.29%	-13.7%	-1.70, $P < 0.10$
Severe anemia, PSM	0.00%	0.36%	-100%	-2.19, $p < 0.05$
Moderate anemia, PSM	7.03%	9.54%	-26.3%	-1.97, $p < 0.05$

Hemoglobins Differ in Women with and without Malaria.

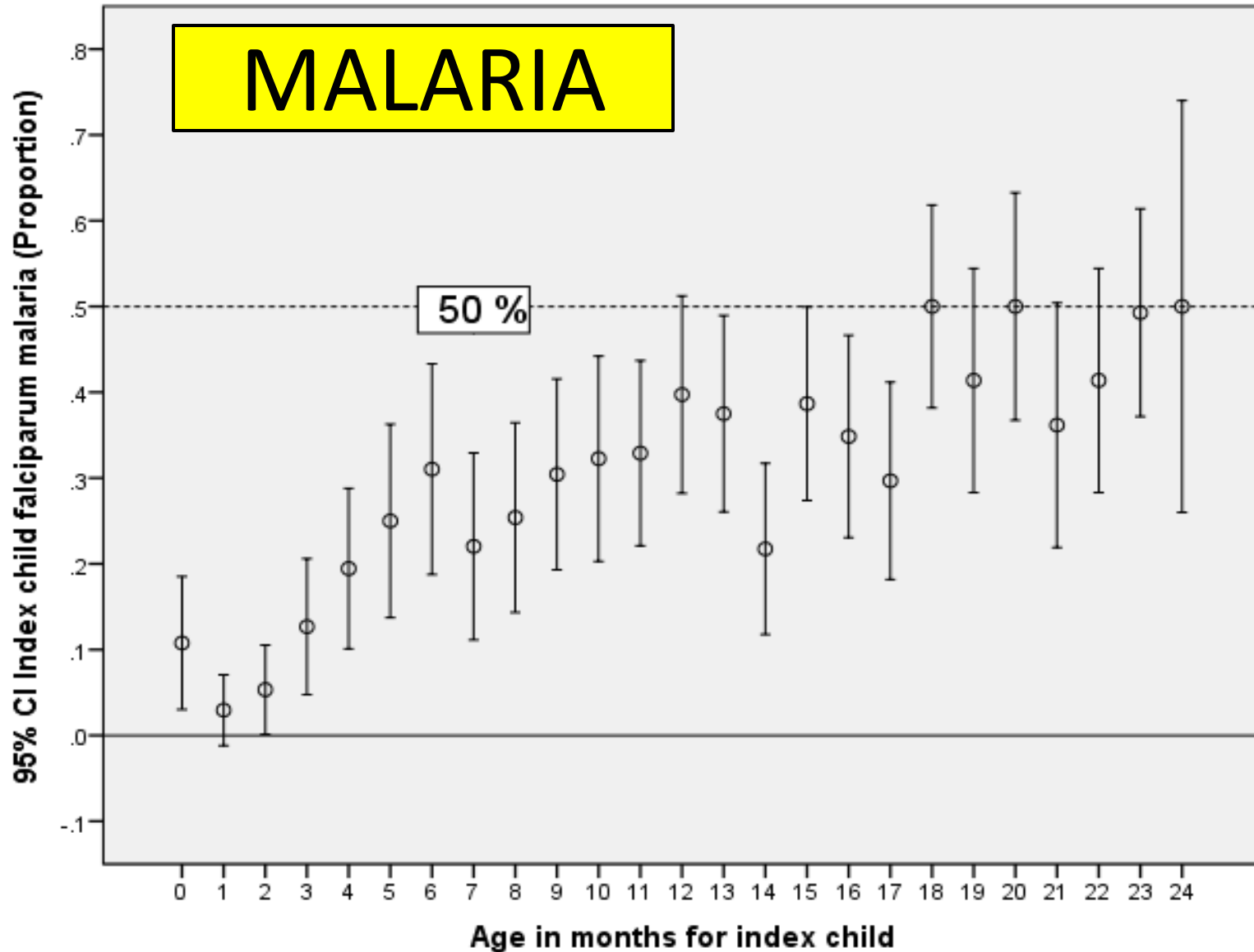
- In 3,467 assessed women aged 15-70 (mean age 30.6 ± 8.4 years), **11.8% (408/3467)** had malaria. Hgb values were **12.45 ± 1.49** and **12.96 ± 1.56** g/dL, respectively, in 403 and 3035 women with and without malaria ($p < 0.001$). **$\Delta = -0.51$ g/dL.**
- **Effect of F&V = $+0.19$ g/dL.**

Malaria Prevalence and Hemoglobins in Children 0-24 Months of Age.

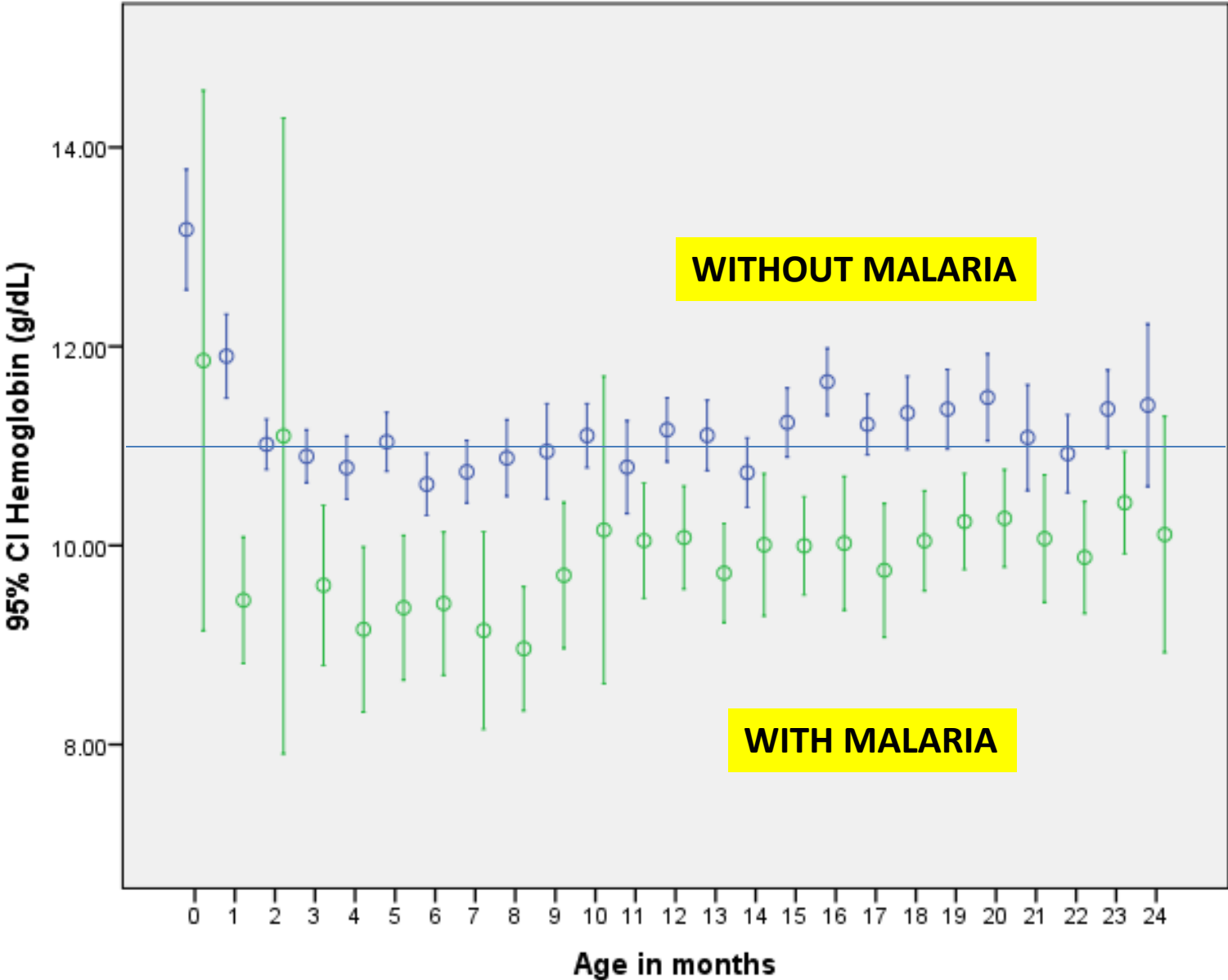
- In 2,008 index children aged 0 to 24 months, malaria prevalence increased from < 3% to **50%** with age (next slide). Overall mean Hgb values differed significantly with (n=483) and without (n=1450) malaria (**9.94 ± 1.57 versus 11.20 ± 1.56 g/dL, $p < 0.001$)**
- **$\Delta = - 1.26$ g/dL!**

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Falciparum malaria in Index Children living at or below 1500 meters

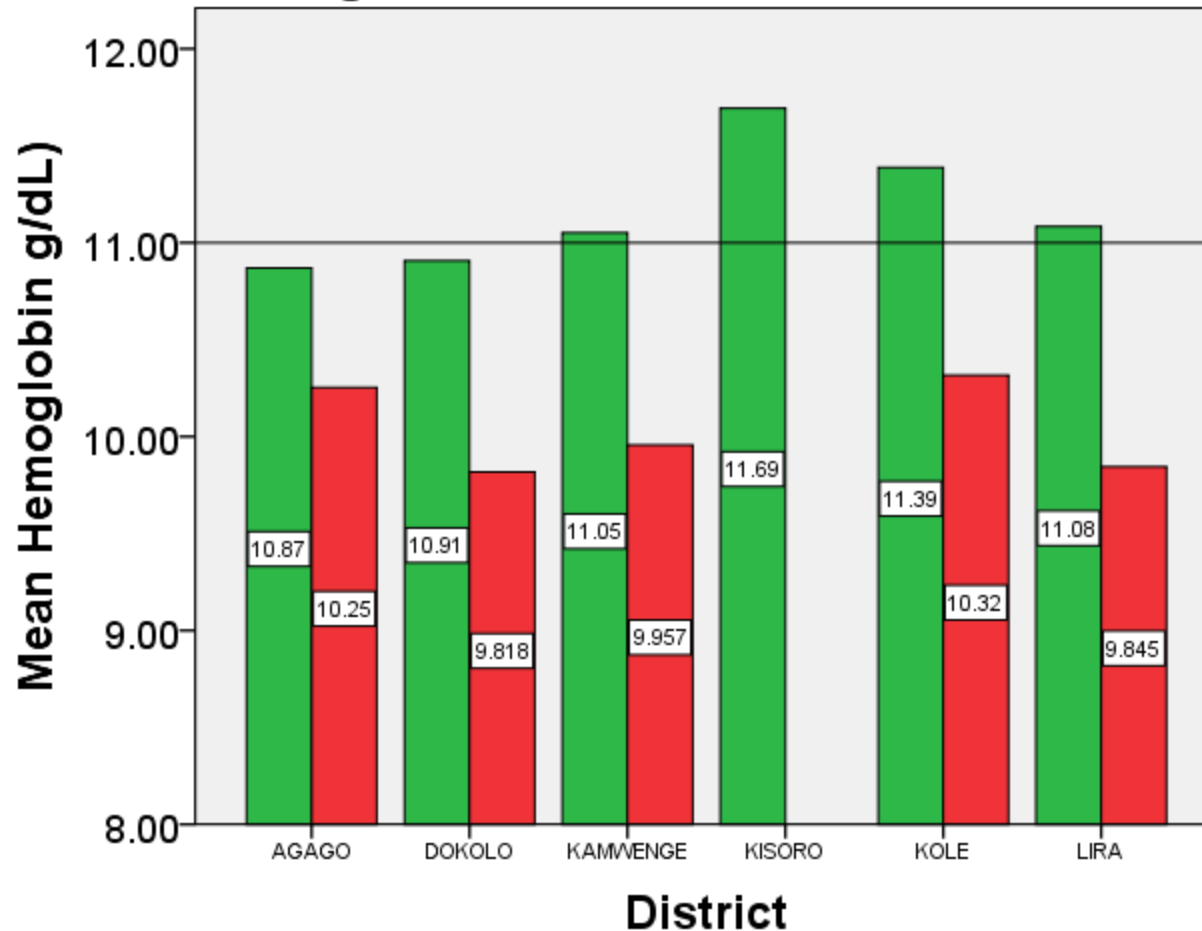


Hemoglobins in children with/without malaria by age



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Mean Hemoglobin in children \leq 24 months.



DISTRICT SPECIFIC
DATA

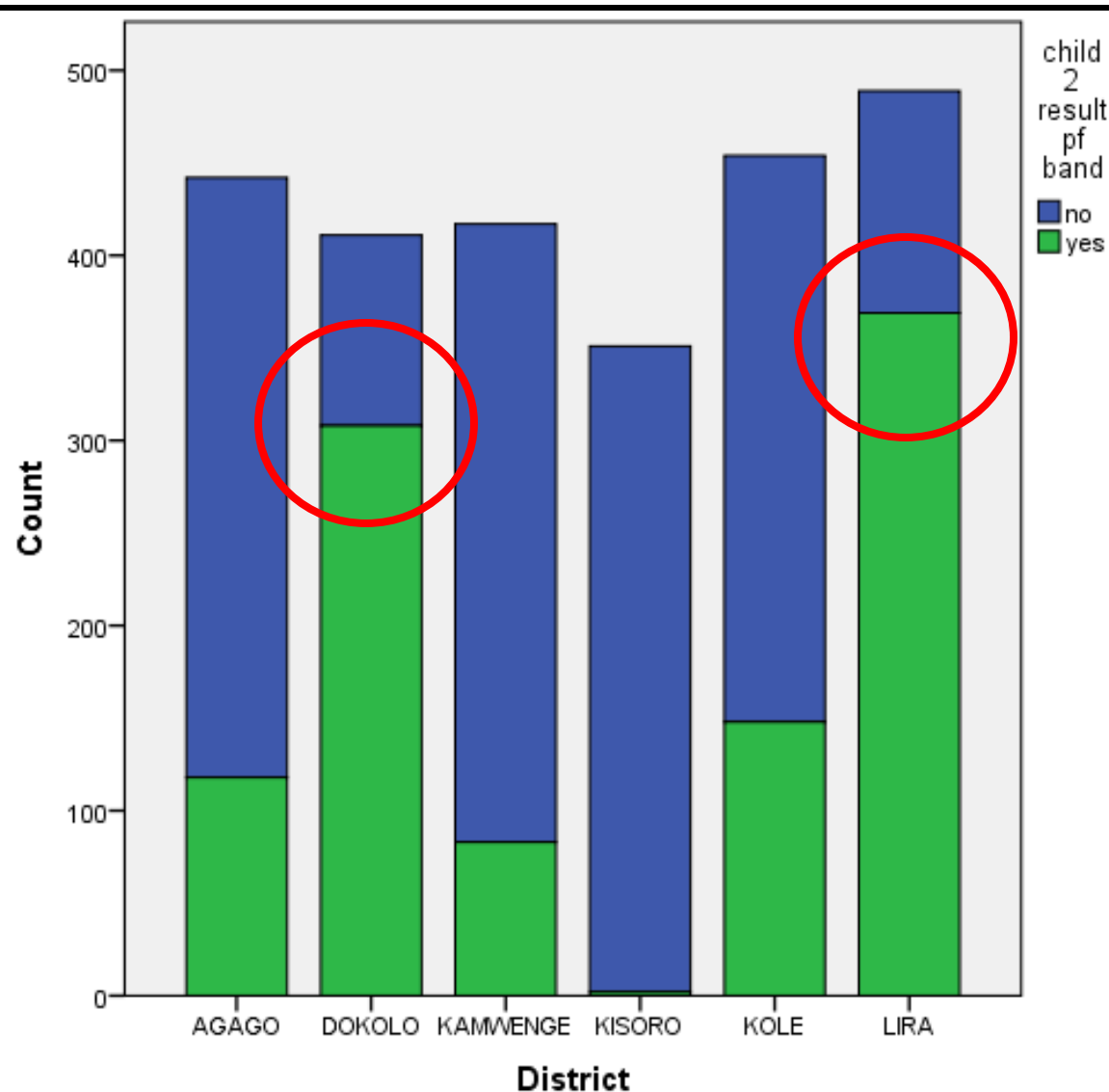
Green – no
falciparum
malaria

Red – with f.
malaria

*Kisoro – no
index children
had malaria

*All differences between children with and without malaria in a given district are significant

Crude malaria rate in children 24-60 m

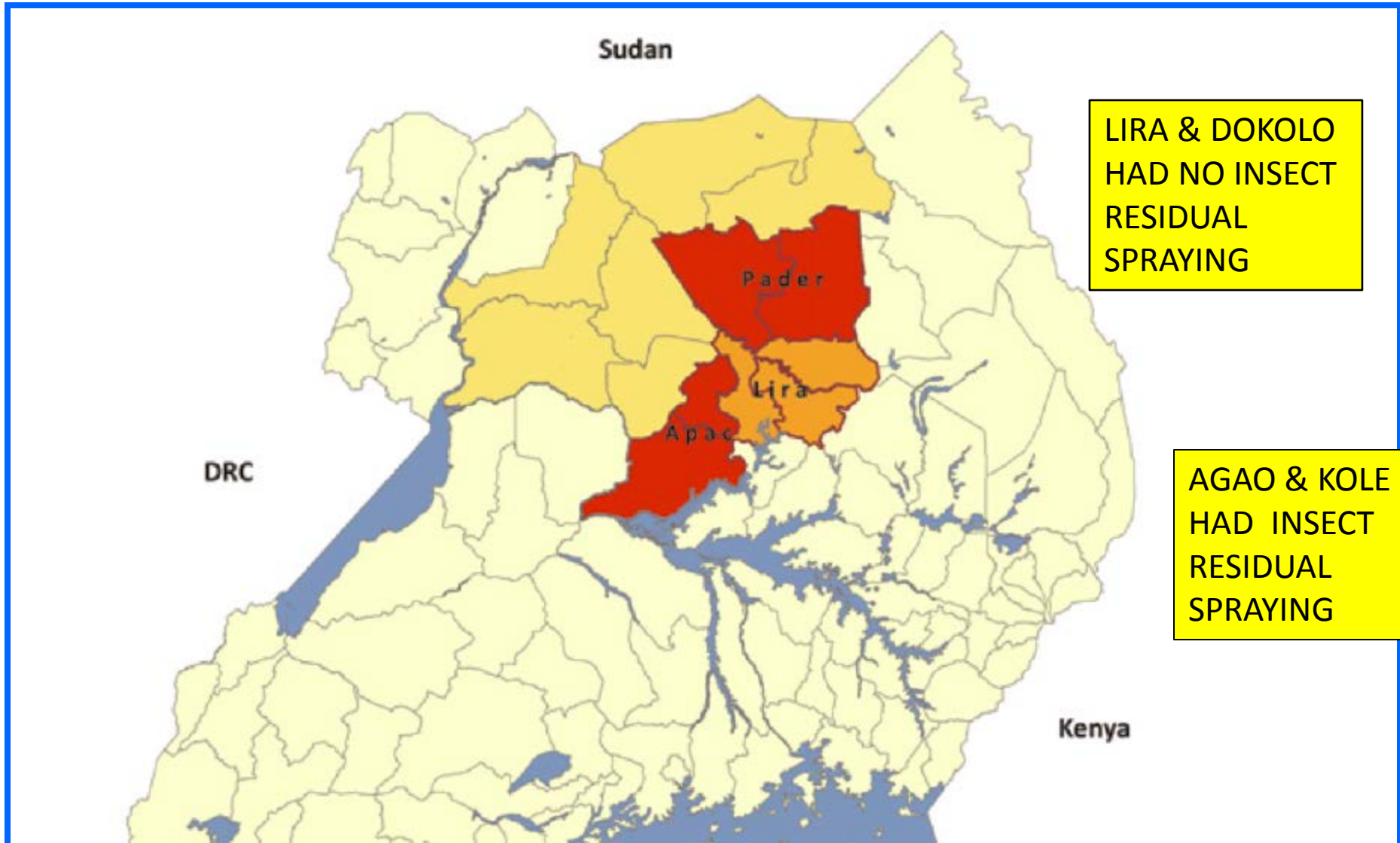


**LIRA AND DOKOLO
HIGHEST RATES**

**AGAGO AND KOLE
MUCH LOWER**

**THESE DISTRICTS
ADJACENT!! WHY
MALARIA PREV.
SO DIFFERENT?**

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With or without IRS

- Anemia in children < 24 months related to:
- North with IRS: Malaria (OR 3.1, $p < 0.0001$), F&V preventive (OR 0.59, $p = 0.0125$), Livestock a risk for malaria (OR = 1.36, $p = 0.018$) if $\geq 24m$
- North without IRS: All the kids have / have had malaria, no protection F&V, livestock no effect
- South without IRS: Malaria OR 3.39, no effect F&V (monotonous starchy diet), livestock risk for malaria (OR 2.29, $p < 0.001$) and anemia (OR 1.42, $p = 0.42$)!

- F&V protective against anemia BUT effect is swamped out by high prevalence malaria especially in children.
- Livestock → meat, milk.... protective against anemia BUT cattle attract mosquitoes that transmit malaria. Higher rates of malaria in households with cattle again swamps out beneficial effect of meat/milk consumption.
- **If you want nutritional programs to successfully combat anemia, you have to reduce malaria first – in Uganda, → IRS + bednets + treatment**

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Production of foodstuffs rich in:
Iron, Micronutrients, Vitamins,
Protein (required for
Hemoglobin synthesis)

SALES

PURCHASES

Household Income; access
to healthcare; purchases &
sales of relevant foodstuffs;
and services, etc.

Consumption of foodstuffs rich in:
Iron, MN, Vitamins, Protein esp.
animal protein (all required for
Hemoglobin synthesis)

Need IRS; bednet use; other
household and community
control of malaria

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