

## Identification of Causal Pathways Determining the Relation Between Pathogen-Specific Infection and Impaired Growth in Children Aged ≤ 59 Months in Mirzapur, Bangladesh

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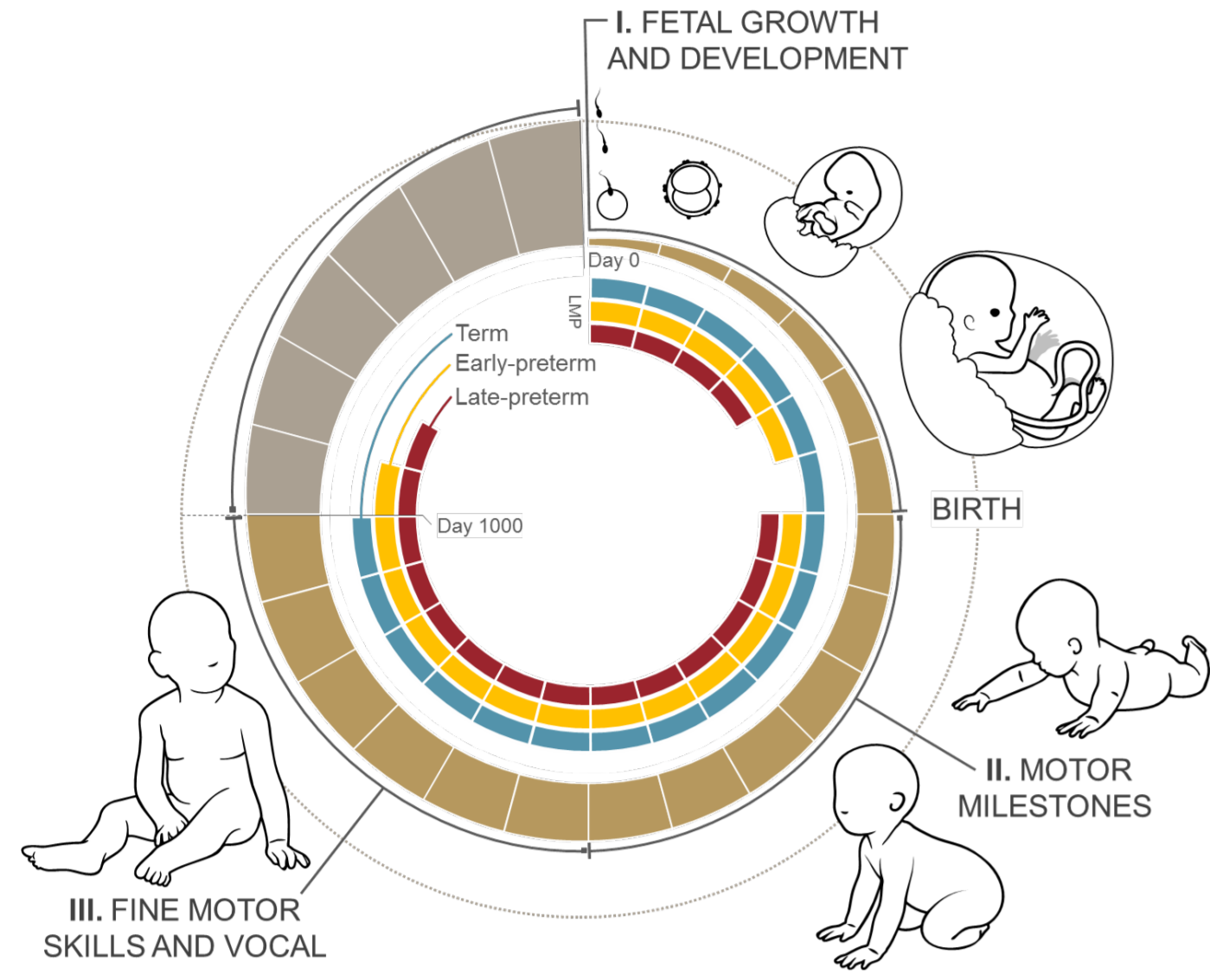


Fig. 1 Healthy Birth Growth and Development Lifecycle diagram.

## Objectives

Burden of childhood diarrhea and malnutrition remain high in South Asia due to inadequate household sanitation, lack of access to improved water, and poor hygiene practices

We aimed to:

- Determine causal pathways linking household

factors, enteric pathogen infections, and impaired growth in children residing in rural communities of Bangladesh

- Identify factors and pathways that are critical points in gastrointestinal parasite transmission pathways and childhood stunting

## Methods

- Structural Equation Models (SEM) approach used to evaluate directed dependencies among drivers of growth impairment among Bangladeshi children
- Stool collected from case and matched control children enrolled in the Bangladesh component of Global Enteric Multicenter Study (GEMS) screened for bacterial, viral, and protozoan pathogens
- Children's height measured at enrollment
- Information was collected about household water, sanitation and hygiene practices, handling of animal and child feces, maternal education, and water treatment and storage
- Paths specifying direct and indirect effects of household reservoirs and hygiene behaviors on enteric infections and childhood stunting (HAZ < -2) were evaluated using SEM
- Direct, indirect, and overall effects of model variables were calculated using coefficients from best-fitting model

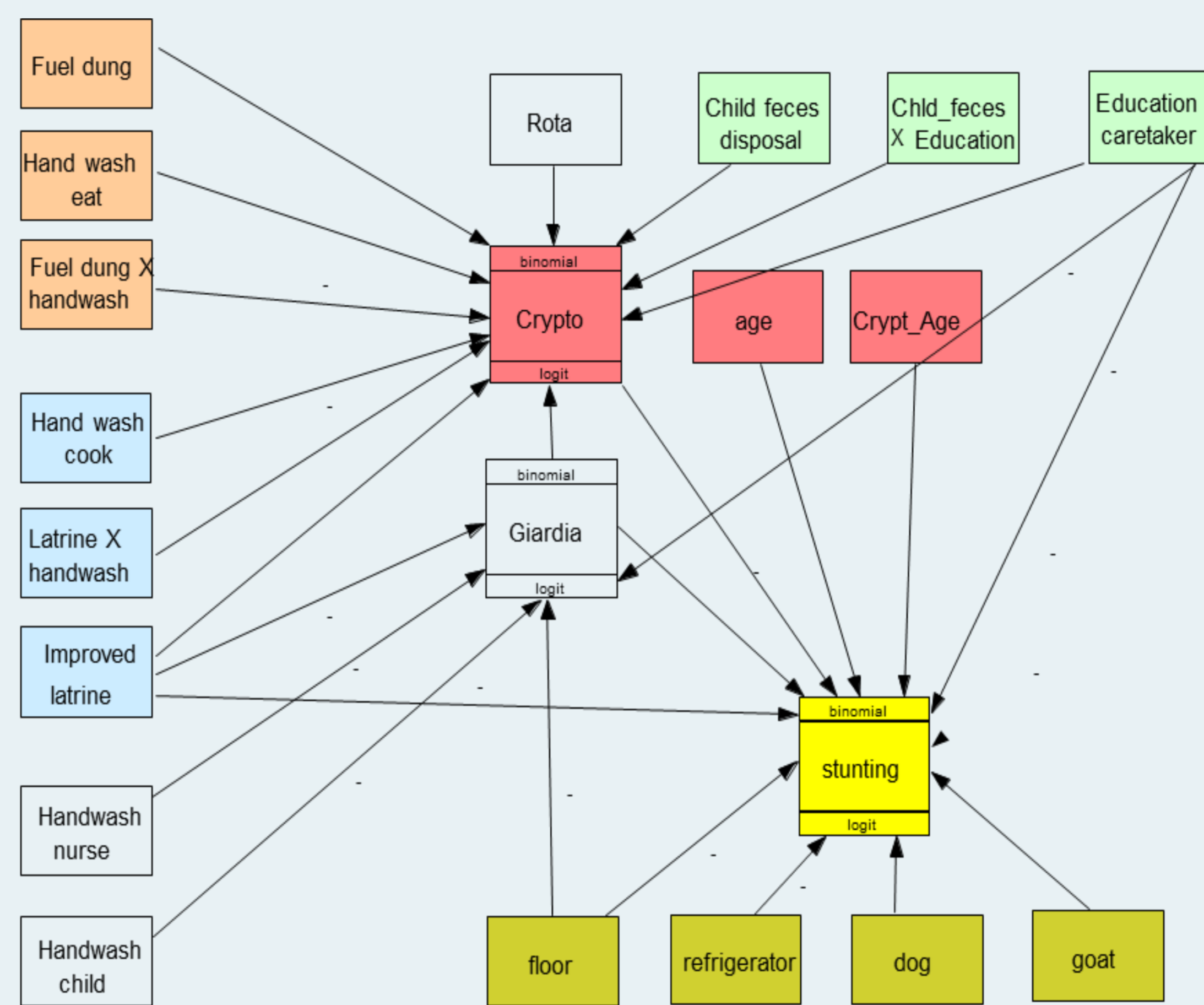


Figure 2. Household factors are risk factors for childhood stunting through direct pathways or effects on *Cryptosporidium* and *Giardia lamblia* infections

	Direct Effect coefficient	Indirect Effect coefficient	Full Effect coefficient
<b>→Stunting</b>			
<i>G. lamblia</i> co-infection	0.34	-0.28	0.06
<i>Cryptosporidium</i> infection	-0.37	0.00	-0.37
Children's age	0.02	0.00	0.02
Interaction: <i>Cryptosporidium</i> infection X children's age	0.03	0.00	0.03
Possess dog	0.17	0.00	0.17
Possess goat	0.17	0.00	0.17
Tile or concrete floor	-0.30	-0.15	-0.45
Possess refrigerator	-0.64	0.00	-0.64
Wash hand before nursing child	0.00	-0.01	-0.01
Wash hand after handling child	0.00	-0.11	-0.11
Caretaker education	-0.50	-0.12	-0.62
How child's feces disposed	0.00	-0.41	-0.41
Interaction: Caretaker education X How child's feces disposed	0.00	0.43	0.43
Animal dung used for fuel	0.00	-0.29	-0.29
Hand wash before eating	0.00	-0.27	-0.27
Interaction: using animal dung for fuel for cooking X hand wash before eating	0.00	0.41	0.41
Hand wash before cooking	0.00	0.41	0.41
Improved latrine use	-0.56	0.16	-0.40
Interaction: Latrine X hand wash before cooking	0.00	-0.48	-0.48

Direct, indirect, and full effects of household pathogen reservoirs, hygiene behaviors, and parasite infections on stunting

## Results

- Household factors were risk factors for childhood stunting through direct pathways or effects on intestinal parasite infection
- Giardia lamblia* and *Cryptosporidium* infections were associated with stunting with increased child age
- Dogs or goats directly associated with increased stunting; household refrigerators or non-dirt floors associated with reduced stunting
- Cow dung fuel use, when caretakers reported no handwashing before eating, was associated with increased *Cryptosporidium* prevalence
- Traditional latrine associated with increased *G. lamblia* and *Cryptosporidium* infections when caretakers handwashed before cooking
- Increased caretaker education reduced stunting directly, but no education increased stunting through *Cryptosporidium* infection when child feces disposal

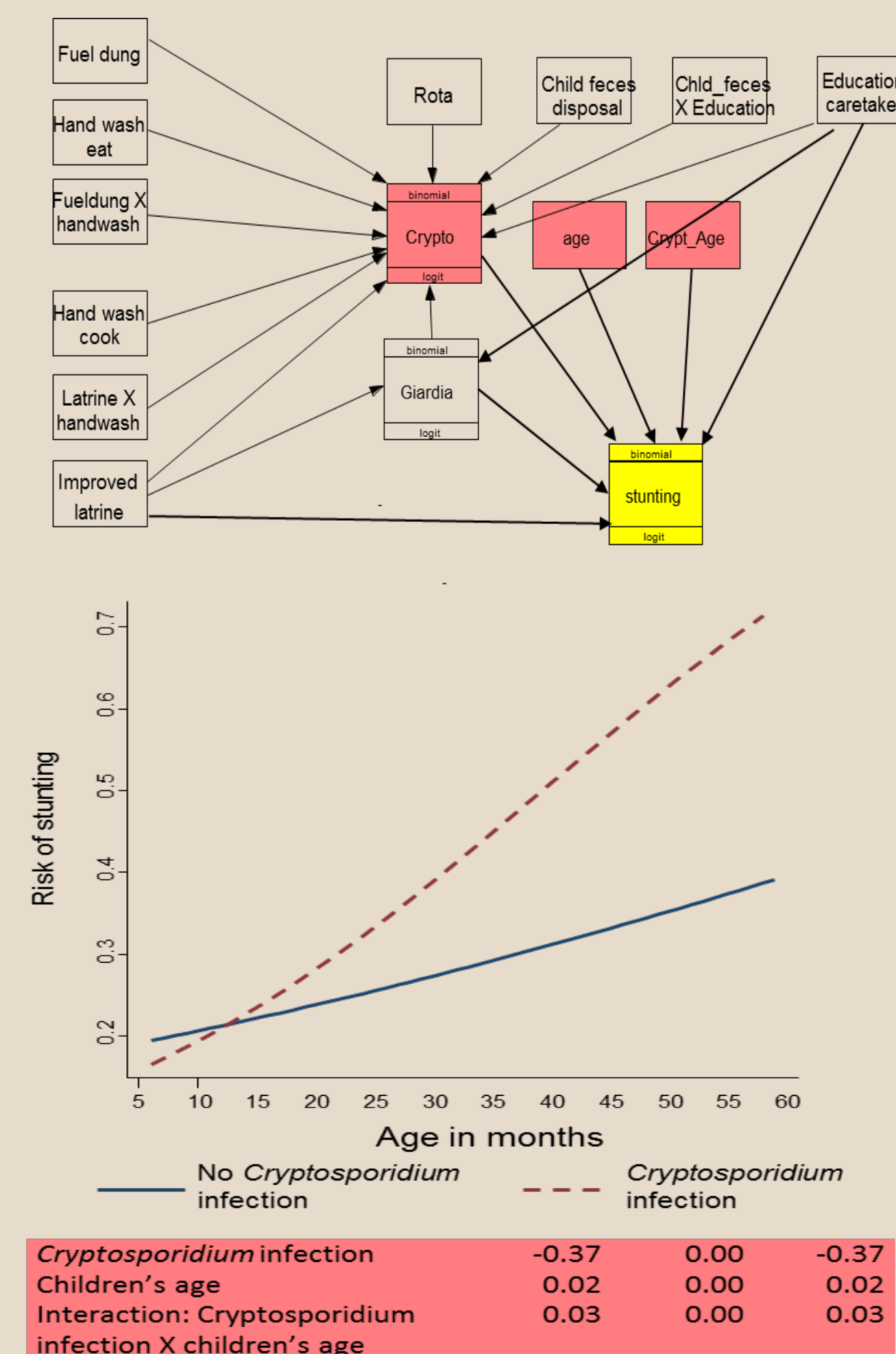


Figure 3. *Cryptosporidium* infection increases the risk of stunting with increasing age of child

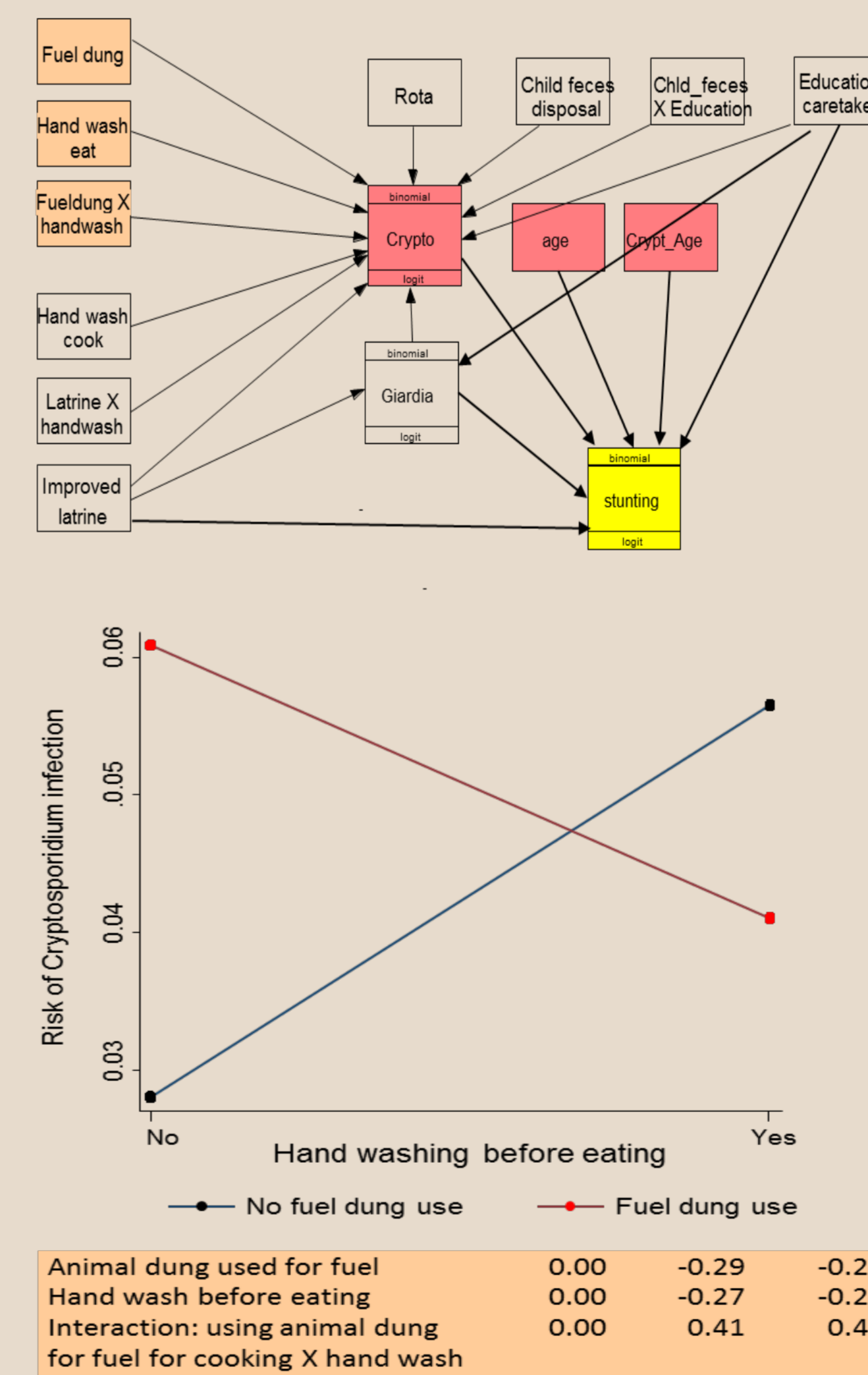


Figure 4. *Cryptosporidium* infection increases with cow dung fuel use and no handwashing before eating

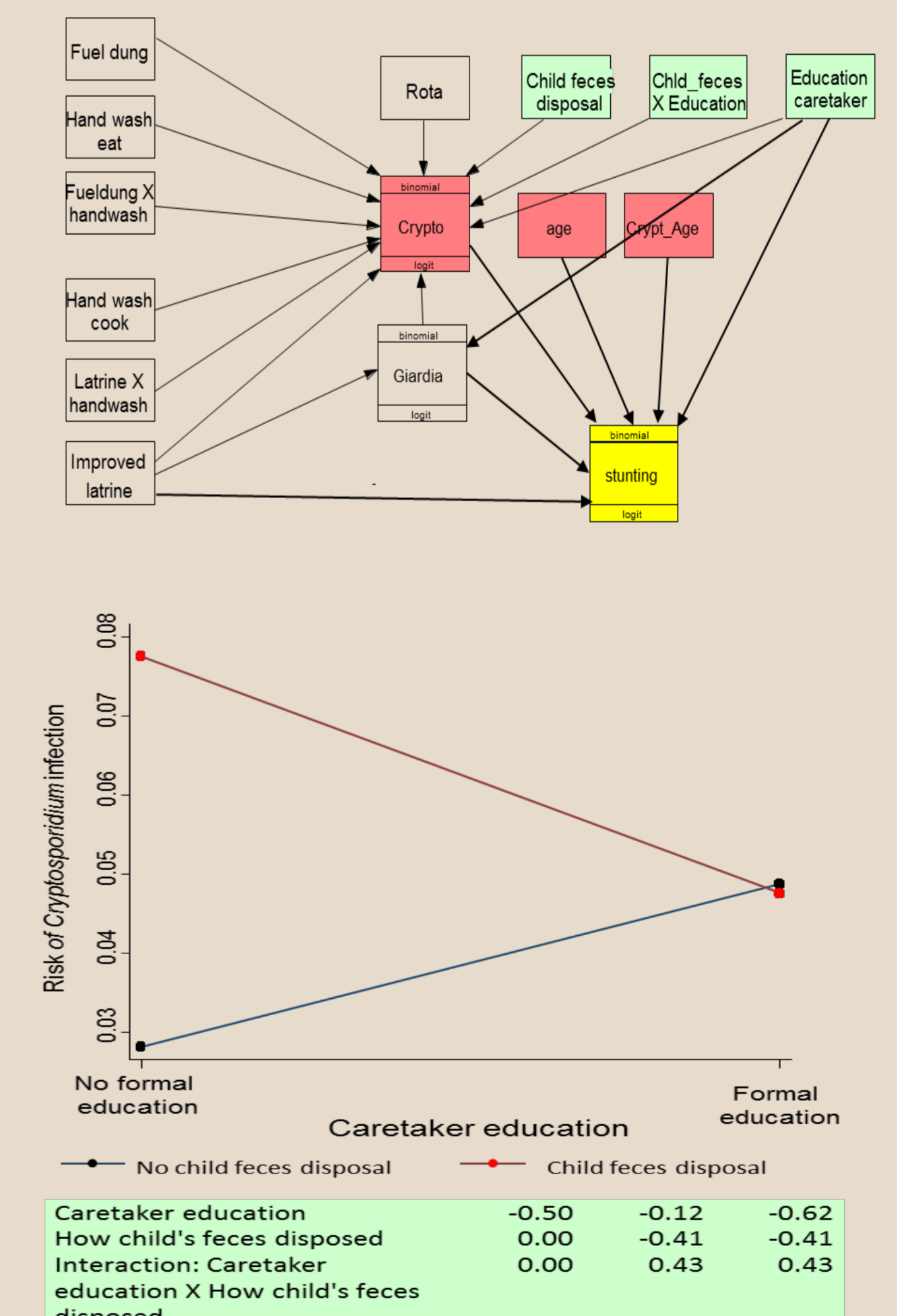


Figure 5. Caretaker education had greatest effect on stunting through direct and indirect pathways

## References

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## Conclusions

- Analysis identified factors that are critical points in gastrointestinal parasite transmission pathways and childhood stunting in rural Bangladesh
- Identified pathways involve different human and animal pathogen reservoirs that are modified by specific hygiene practices and behaviors
- Findings suggest that WASH interventions concerned with reducing childhood stunting in Bangladesh should include efforts to limit exposure to animal sources of pathogens
- Models with further testing can be important tool in efforts to reduce burden of stunting through targeting of households and communities using indicators of exposure risk

## Acknowledgement

We wish to thank the Global Enteric Multi-Center Study team for their input in the analysis