

# Brain Imaging of Nutrition Related Cognitive Development in Rural Gambia: Studies from Birth to 24 Months of Age

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## Aims

- To establish functional near infrared spectroscopy (fNIRS) as a low cost, non invasive brain imaging tool for assessing neurocognitive function in infants from birth in resource poor settings.
- To provide early biomarkers of cognitive development to inform and evaluate nutritional intervention strategies.

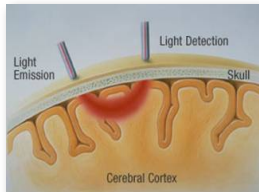
## Method

- fNIRS is an optical imaging technique which measures changes in brain blood flow and oxygen consumption associated with neuronal activation.
- Very low levels of near infrared light are used to provide a continuous and non invasive measure of oxy- (HbO<sub>2</sub>) and deoxy- (HHb) haemoglobin. The characteristic response to neuronal activation is a localised increase in HbO<sub>2</sub> and decrease in HHb.
- fNIRS offers superior spatial resolution to EEG, and unlike fMRI, is well suited to field studies. The technique is completely safe, low cost and requires minimal set up and training.

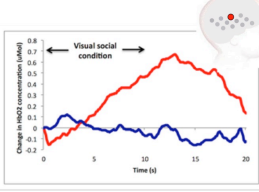
### 1) Source and detector probes



### 2) shine and detect light



### 3) and measure changes in HbO<sub>2</sub> (red) and HHb (blue) in response to neuronal activation



## Study Protocol

A total of 99 infants were studied between birth and 24 months of age. Infants wore an fNIRS source detector array over the right hemisphere. Newborn infants were presented with voice and non-voice auditory stimuli whilst sleeping. All other age groups were presented with social and non social visual stimuli in addition to the auditory stimuli, whilst sitting on their parent's lap. Continuous fNIRS measurements of the changes in HbO<sub>2</sub> and HHb were used to detect regions of significant cortical activation.

## Results

● Brain regions showing significant cortical activation

### Experimental Setup



### 0-2 months



### 4-8 months\*



### 12-16 months



### 18-24 months



### VISUAL

social vs. non-social



INFANTS WERE SLEEPING

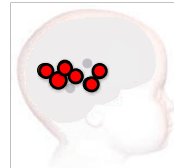


### AUDITORY

voice vs. non-voice

cough  
cry  
throat-clear  
laugh

rattle  
shake  
running water



\* 4-8 month Gambian infants show similar activation to age matched UK infants

## Conclusions

- fNIRS can be used to measure neurocognitive function in infants from birth to 24 months of age in a resource poor setting.
- Cross sectional and longitudinal studies showed responses to auditory and visual stimuli in specific brain regions.
- fNIRS may be used to elucidate typical and atypical brain development from birth, and hence, to investigate the effects of nutritional insults and interventions in global health studies.

## More Information

Email: [info@globalfnirs.org](mailto:info@globalfnirs.org)

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Lloyd-Fox, S., Papademetriou, M., Darboe, M. K., Everdell, N. L., Prentice, A. M., Moore, S. E., & Elwell, C. E. (2014). Functional near infrared spectroscopy (fNIRS) to assess cognitive function in infants in rural Africa. *Nature Scientific Report*, 4:4740. DOI: 10.1038/srep04740

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