LETTER OF INTENT

Usual egg intake of Peruvian children and its contribution to child development: the MAL-ED study

Laura E Caulfield, PhD1, Pablo Yori, RN MPH2, Laura Murray Kolb, PhD3

1Center for Human Nutrition, The Johns Hopkins Bloomberg School of Public Health, Baltimore, MD; 2Department of International Health, The Johns Hopkins Bloomberg School of Public Health, Baltimore, MD; 3Department of Nutritional Sciences, The Pennsylvania State University, State College, PA.

INTRODUCTION

As put forth by Iannotti and colleagues in their 2014 review, eggs have been consumed throughout human history, but their full potential for improving maternal and child health and well-being has not been fully characterized. Because eggs are a high quality protein source and contribute key nutrients (essential fatty acids, choline, zinc, vitamin B12, \textit{inter alia}) for brain development (myelination, neurogenesis, synaptogenesis), eggs may be vital for cognitive development in low-income infants and children with limited access to alternative food sources or supplements.

Our proposal seeks to utilize extant data from a birth cohort study in Iquitos, Peru to evaluate the association between usual egg consumption and child development, both at 24 months of age and at 5 years of age. Why use these data? Infants and children in the study have reported frequent consumption of (chicken) eggs; for example, between 9 and 24 months of age median usual egg consumption is 0.94 servings/day, with an interquartile range of 0.6 to 1.25 servings/day. Eggs (scrambled or fried) are amongst the first complementary foods fed to infants, and eggs continue to be consumed when children shift to family foods.

As part of the “Etiology, Risk Factors and Interactions of Enteric Infections and Malnutrition and the Consequences for Child Health and Development (MAL-ED)” protocol, we have quantified dietary intakes (24-hr recall) monthly (beginning at 9 months of age) which will allow us to quantify over time usual intakes of egg yolk, white and whole egg, and we have high quality assessments of global development (BSID III), language development, and temperament during the first 24 months, and we are currently finishing up our evaluations of the children at 5 years of age with assessments using WPSSI and other standardized instruments of cognitive, social and behavioral development. Because, we also have assessments of the home environment, socioeconomic factors, maternal education, reasoning ability and mental health symptoms, exposure to enteropathogens (including \textit{Campylobacter}), illnesses and other confounding and influencing factors, we argue that we are uniquely positioned to evaluate the contribution of eggs to cognitive development during childhood, a question of mutual interest to the applicants and the Egg Nutrition Center.

SPECIFIC AIMS

1. To quantify usual intakes of egg white, yolk and whole egg in Peruvian infants and children from 9 months to 24 months of age, and from 24 to 60 months of age, as well as from specific periods (for example, 9 to 15 months);
2. To evaluate the associations between usual whole egg consumption (g/d) and child development:
   a. consumption from 9-24 months and global development at 24 months of age, adjusted for potential confounding factors;
   b. consumption from 9-60 months of age and cognitive, social and behavioral development at 60 months of age, adjusting for potential confounding factors and intervening factors (for example, pre-school participation);
   c. consumption from 9-15 months of age and language development at 15 months of age;
APPROACH
The overall design and the methods for each component of the original study (to 24 months) have been published (see CID 2014; 59 (suppl 4)) as well as a description of each site. Overall, we enrolled 303 newborns in Peru, have data on about 250 at 24 months and about 200 at 5 years of age. The MAL-ED investigators have papers submitted on the psychometric analyses for each of our developmental assessments, and MAL-ED psychologists will be performing the psychometric analyses on the measures at 5 years over the next 6 months. MAL-ED analyses regarding growth and development outcomes identify that the protein density of the diet from complementary foods, and including animal source foods, affect the growth and development of these children at 24 months. Through MAL-ED, we are currently preparing papers on the contribution of various food sources to energy, macro and micronutrient intakes in these children. We have already published on the causes of diarrhea and have a paper on the epidemiology of Campylobacter. These papers create a context in which we will conduct our analyses.

We intend to utilize the multiple 24 hour recall data to create child-level egg intakes (g/d) over the time periods to characterize exposure to eggs. For example, children contribute up to 17 recalls to characterize their usual egg consumption between 9 and 24 months. We will utilize regression methodology to evaluate the association of egg intake to development score, for example, BSID score at 24 months. We would then consider covariates (sex, maternal education and/or reasoning ability, recent illness, aspects of the home environment, socio-economic factors, duration of breastfeeding, and perhaps overall energy intake from complementary foods). We will utilize this same process to evaluate the associations at 60 months, but also consider influential factors such as pre-school attendance.

TIMELINE AND BUDGET
We propose to conduct this work over an 18-month period. During months 1-3, we will hire a data analyst to conduct the statistical analysis. First, we will prepare the dataset to precisely and completely characterize the usual egg consumption for each child and begin addressing aim 1. We will first address aim 1 for the younger age period (24 months) during months 2-6, and for the second period 24-60 months from months 7-12. During months 7-12, we will address aim 2 with respect to the outcomes at 24 months, and then address aim 2 (outcomes at 60 months) from months 13-18.

There is no support from MAL-ED for the analyses proposed here. We request a total of $201, 006 over the 18-month period. Dr. Caulfield is the MAL-ED lead on the technical subcommittee for all nutrition measures and her team has performed data cleaning, recipe calculations, creation of nutrient composition tables and calculation of food and nutrient intakes. Dr. Murray Kolb is lead for all cognitive measures, managing the training experts, the video quality monitoring of the assessments, and the psychometrics. Mr. Yori, is an infectious disease specialist, and is MAL-ED co-lead supervising data collection and overall data management for the Peru site. Personnel costs at Hopkins are requested for years 1 and 2 ($120,861/$45,220); Caulfield is supported at 5%, and Yori at 3%, with funds requested for a FT data analyst/statistician. Other direct costs for supplies, a laptop for the data analyst, travel to a meeting to present findings and publication costs total $3,950 over the project period. Support for Murray-Kolb is requested at 3% in years 1 and 2 ($6,468/$3,234), and we request $3,000 over the project period for Angel Orbe Vasquez, the psychologist in Iquitos who performed the developmental assessments for the study. Finally, IDC is included at 10% ($13,123/$5,150).

CONTRIBUTION OF RESEARCH TO EGG INDUSTRY
The call for proposals identifies an interest in observational studies evaluating the relationships between intake of whole eggs and cognitive function in infants and children. Here we will evaluate whether the usual consumption of eggs during infancy, childhood and the pre-school years contributes to various aspects of child development during the early years (to 24 months) and development and school readiness at 5 years. Although our data originate from Peru, we argue that these data can uniquely inform the industry on this matter because of the careful and rigorous collection of data on dietary intakes and child development, as well as collection of data on confounding and modifying factors.