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An early-warning system for child health in West Africa

Researchers at UC Santa Barbara have developed a method for predicting the likelihood of low birthweights in West Africa, based on climate and socioeconomic data. Their model, when incorporated into an early warning system for child health in the region, could give decision makers and aid organizations the time necessary to prevent malnutrition and its downstream effects.

“Policy makers, humanitarian agencies, other international organizations, they may be able to look at the climate data now and then anticipate that there will be large-scale low birthweight issues,” said Shraddhanand Shukla, a researcher in the Department of Geography at UCSB, who specializes in drought monitoring and climate forecasting. “And perhaps something can be done about it.”

Shukla’s paper, co-authored with fellow UCSB geography research scientist Frank Davenport, appears in the Proceedings of the National Academy of Sciences.

A food-stressed start to life

Malnutrition at any age is bad, but food insecurity is a particularly dire situation for the youngest in West Africa, a region that faces recurring hunger crises due to climate change, unstable economy and conflict. Children born with low birthweights — often the result of maternal malnutrition and other stressors during pregnancy — are likely to experience negative short- and long-term health effects as a result of

inadequate nutrition.

“Being born with lower birth weight in a food-stressed country can set off a domino effect that can be very difficult to recover from,” said Davenport. Undernourished babies can suffer lifelong developmental and cognitive impairments, poor immune function, and just be generally less robust to stressors. “If there’s a food or climate shock at age two or three,” he continued, “they’re just more likely to be a bit more sensitive to that.”

But what if there was a way to prevent low birthweights or minimize their likelihood, thereby giving the child a better start in life? For that to happen, the researchers would first need to be able to predict when mothers-to-be were more likely to have low birthweight children. They had some clues.

“Fertility tends to be seasonal in parts of the world — definitely in West Africa — and if we roughly know when people are having babies, we might really be able to build along this early warning chain,” said Davenport, who studies the intersections of climate, food systems, food security and human health.

Previous research also had revealed small but important connections between climate conditions and pregnancy outcomes in the region. Additionally, they had data from the Demographic and Health Surveys Program (DHS), a program that collects socioeconomic data from populations all over the African continent, to provide variables that may affect birthweight. Access to electricity, water sources, urban vs rural settings — environmental and social factors that affect the expectant mother and her baby in utero — are among these variables.

The challenge for the researchers was to take the data they had and build it into a forecast model that covered the baby’s climate exposure from preconception to birth — a subseasonal time frame that lies between short-term weather forecasts and long-term climate predictions. This months-to-year window is crucial for early management decisions in various realms, including agriculture, water and health.

“Could we use climate data over that time period to predict birthweight outcomes?” Shukla said. Births tend to occur during the rainy “lean months” of May to September, in between planting and harvest, when pregnant women have to rely on surplus food. They used temperature and rainfall data from the 12 months preceding birth to create a benchmark for their outcomes.

They subsequently whittled that window back to just the rainy months, finding that focusing on the critical “lean months” of the previous year gave them the most pronounced forecast accuracy, according to Davenport.

“If we use the previous year’s rainfall in the lean season, we can predict people’s food accessibility a year in advance,” Shukla explained.

They then scaled that back to August.

“We found that if you use only the rainfall from the most critical month — which is August in this case — we can get a reasonably similar skill of the model compared to when we were using the full rainy season rainfall,” Shukla said, adding that If they could use subseasonal forecasts to predict August’s rainfall, that would give managers and aid organizations more time to address the conditions leading to low birthweight outcomes.

Similarly, they found that while demographic information was useful, it didn’t need to be granular, and they could get a similar level of performance from their model with only the broadest strokes of information. This is particularly important with places like West Africa where demographic data can be scarce and expensive to acquire, and the loss of USAID, which was a supporter of DHS studies, means that this information may become harder to access. Fortunately, the researchers said, other open sources of data may provide information about conditions, including satellite imaging and remote sensing.

“Open-source datasets and approaches like these might become even more valuable with the current situation,” Shukla said. Additionally, the researchers say, with similar sets of data in other food-stressed part of the world, models like this one could make similar forecasts about birth weights there.

“I do think we could expand it, but we would want to think carefully about what are the populations it would apply to,” Davenport said. “The model would be tweaked, depending on where it went.”

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