



INITIATIVE ON

Resilient Cities

AI-assisted dietary assessment and personalized “nudges” in urban Ghana

Preparing for scale-up

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The challenge of unhealthy diets

Diet-related risk factors cause 11 million deaths annually, making them the largest single factor included in the Global Burden of Disease analyses (Afshin et al. 2019). Recent trends associated with urbanization and the “nutrition transition”—which is characterized by shifts to unhealthy diets and increased consumption of energy dense and nutrient poor processed foods and decreased physical activity—have led to increases in rates of overweight and obesity (Popkin et al. 2020). Regular data collection to document population-level dietary intake is essential for effective, evidence-based nutrition actions (Hargreaves et al. 2022). However, collecting and analyzing dietary data is complex and expensive (Bell et al. 2017).



Dietary assessments typically involve the use of the multi-pass 24-hour recall (24HR) method, which has been validated in adults reporting their intake and/or that of their young children (Gibson and Ferguson 2008), and to some degree in adolescents. The costs associated with conducting a 24HR are approximately \$500 per recall (Adams et al. 2022). Mobile phone-based tools have potential to lower the cost of diet assessment; however, evidence is lacking on the validity and feasibility¹ of conducting phone-based assessments in low- and middle-income countries (LMICs) (Bell et al. 2017).

Addressing these challenges in urban settings through AI-assisted technologies

Imagine a global-scale artificial intelligence (AI) assistant that diagnoses diet-related problems in vulnerable populations. It also delivers nutritional advice tailored to each individual, based on accurate

¹ Validation relates to how accurate an alternative assessment method is relative to weighed records, the gold standard for diet assessment. Feasibility relates to how acceptable and usable the new technology is to users.

AI-facilitated diagnostics, allowing users to improve food choices. The AI tool also provides governments and partners with real-time diagnostics that can feed into monitoring systems. In pursuit of this tool, we developed an AI-based phone application called PlantVillage Food Recognition Assistance and Nudging Insights (FRANI). Previous studies in Ghana and Viet Nam, showed that FRANI can estimate food and nutrient intakes at least as accurately as a dietician undertaking a 24HR (Folson et al. 2023; Nguyen et al. 2022). Moreover, a pilot 4-week experiment showed that using PlantVillage FRANI to “nudge” adolescents in Viet Nam toward healthier food choices was feasible and effective (Braga et al. 2023).

The CGIAR Research Initiative on Resilient Cities aims to strengthen knowledge on urban diets, nutrition and food environment challenges, and interventions to address them. As part of these activities there is a focus on understanding how to reduce the time and costs associated with collecting robust individual-level dietary intake data. We therefore conducted validation and feasibility studies of PlantVillage FRANI in urban youth (females 18-24 y of age) in Ghana which, if successful, could introduce major cost savings in dietary data collection and provide an intervention with potential to improve diets at scale.

Implications and scale-up considerations

Evidence generated by these studies shows PlantVillage FRANI’s potential: By comparing PlantVillage FRANI to weighed records, the gold standard for dietary assessment, we found that PlantVillage FRANI accurately estimated nutrient intake in 64 female participants aged 18–24 years. Moreover, we conducted an 8-week individually randomised study involving 60 participants in the same age group, randomized to receive PlantVillage FRANI with full nudging functionality or a version of PlantVillage FRANI including only dietary assessment. The study included 14,579 food records and 2,614 person-day records. PlantVillage FRANI was found to be acceptable, likeable and usable by all participants. Effect estimates showed that PlantVillage FRANI improved dietary diversity, and EAT Lancet Diet Quality scores (when modelling exposure duration). PlantVillage FRANI use was thus found to be feasible and effective in nudging users toward healthy food choices, consistent with results Viet Nam (Braga et al. 2023).

The implications of this work are far-reaching: Using FRANI to fill the diet data gap and collect dietary intake data in Ghana would require fewer resources — financial, staff expertise, and so on — than other dietary assessment methods. Work is also underway to test PlantVillage FRANI to provide real-time information on the quality of school meals provided by the Ghana School Feeding Program, Ghana’s largest safety net, operating in 11,000 schools and covering 3.6 million children. In addition, the “gamified” version of FRANI provides a potentially scalable intervention to improve diets in adolescents and youth, key lifecycle stages for nutrition that are also hard to reach but have been largely overlooked in nutrition programming. Further work is also warranted, including generating more evidence on the cost-effectiveness of the PlantVillage FRANI nudging intervention in different contexts and at scale.

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