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## Participatory GIS mapping of personal food environments and nutrition vulnerability in four global south cities

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### Abstract

Low-income urban communities in the Global South face substantial nutrition risks, yet conventional area-based food environment metrics often fail to capture how food access is experienced through daily mobility, routines, and constraints. This study used Participatory Geographic Information Systems (GIS) to characterise personal food environments across four dimensions, quantify nutrition vulnerability, and compare dominant drivers across four urban settings: Accra, uMsunduzi Municipality, Kuala Lumpur, and Dar es Salaam. A multi-site cross sectional design integrated participatory mapping and household survey data with nutrition related outcomes. Indicators were coded so that higher values reflected greater vulnerability, normalised to a 0 to 1 scale, aggregated into dimension specific scores, and combined into an overall Nutrition Vulnerability Index. Clear cross city differences emerged. Accessibility related vulnerability was highest in South Africa and lowest in Tanzania, while affordability related vulnerability was most pronounced in Tanzania and Ghana. Convenience related vulnerability was highest in Tanzania and Malaysia. Food insecurity also varied markedly, with the greatest burden observed in Tanzania and the highest proportion of food secure participants in Malaysia. Mean body mass index and obesity prevalence were highest in Ghana and similarly elevated in South Africa, revealing a double burden of food insecurity and overweight. Spatial clustering of vulnerability within cities further showed that nutrition risk is highly localised rather than evenly distributed. These findings demonstrate that personal food environment drivers of nutrition vulnerability differ across low-income urban settings and therefore require context specific responses. By identifying where and how constraints to food access, affordability, and convenience are concentrated, this Participatory GIS framework provides an evidence base for spatially targeted, nutrition sensitive interventions that can support more equitable and resilient urban food systems across the Global South.

**Keywords:** Food insecurity, Global South, nutrition vulnerability, participatory GIS, personal food environment, urban food systems