Empirical estimation of non-linearities in the shared drivers of malnutrition in peri-urban India

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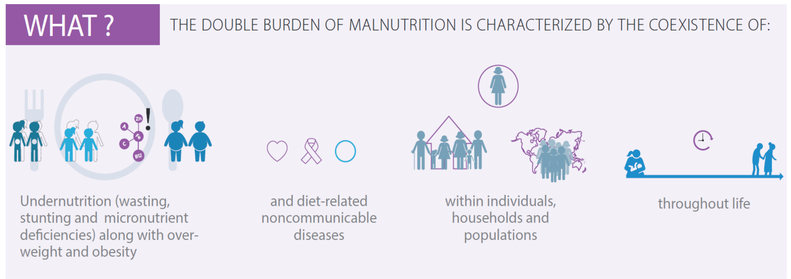
Introduction

The double burden of malnutrition (DBM) is characterized by the coexistence of undernutrition along with overweight, obesity, or non-communicable diseases (NCDs), within individuals, households and populations, and across the life-course[1]



- Several biological, environmental, behavioral, and socio-economic factors are found to be the drivers of DBM.
- Increased healthcare costs, reduced productivity, and decreased economic growth are some of the consequences of DBM[2]

Double duty actions

- Despite the challenges, DBM presents unique opportunities for integrated actions against all forms of malnutrition.
- Such integrated actions are called "double-duty actions" and were introduced in the 2015 Global Nutrition Report.
- The double-duty actions are the interventions, programs, and policies that have the potential to simultaneously reduce the burdens of undernutrition as well as overnutrition[3]
- The double-duty actions ensure the efficient use of the limited resources by addressing multiple goals through a single intervention.
- The rationale for the double-duty actions follows identifying shared drivers of different forms of malnutrition and using them to retrofit existing interventions and create shared platforms to address DBM.

Shared drivers of malnutrition

- Increase in income is associated with reduction in undernutrition, further increase in income is also found to increase overnutrition[4]
- Higher dietary quality (e.g. dietary diversity) initially reduces undernutrtion and increases overnutrtion with further increases[5]
- Urbanization improves undernutrition through improved access to food markets, labor markets, health environment, etc.[6]
- Increase in education years of a mother might not have a significant association with her child's health status until a certain level of education, but start to have an improvement effect after crossing the said threshold[7]
- Similar non-linearities can be expected for age, education, physical activity level, etc.

Research objective

Empirical estimation of the non-linear relationships among the factors associated with multiple forms of malnutrition among women

Study region and sample information

Rural-urban interface of Bangalore - geographical space that extends from outer peripheries of Bangalore city towards the traditionally defined rural areas

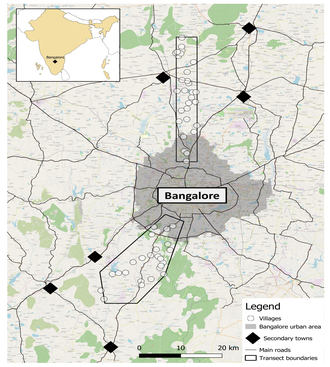


Figure 1. Study area, research transects, and sample villages

- Bangalore is a rapidly growing mega-city in South India
- Rural-urban interface area represents the regions that span from the outer peripheries of Bangalore city to traditionally defined rural areas
- The regions exhibit the characteristics of both urban and rural areas
- Socio-economic survey was conducted between March and August 2022
- Final sample - around 650 women aged 18 years and above

Summary statistics of the sample

Indicator	Mean
BMI	24.42 (4.84)
Central obesity	0.69 (0.46)
Anaemia	0.80 (0.40)
Diabetes	0.13 (0.34)
High cholesterol	0.08 (0.27)
Elevated blood pressure	0.14 (0.34)

Notes: Standard deviations in parentheses. The definition and cut-off values for each indicator of malnutrition presented are based on the suggestion given by the World Health Organization for the respective demographic groups.

Methodology

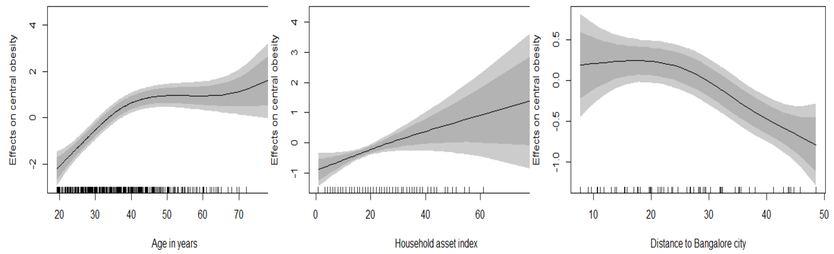
Structural additive regression model to estimate the non-linear effect of drivers of malnutrition. Since our dependent variables are dummy variables which takes value 1 if a individual woman is obese or diabetic and zero if a individual woman is not obese or not diabetic, we assume them follow binomial distribution. The regression models each indicator of malnutrition takes the form:

$$malnutrition_{ij} = \int_{ij}(Z) + \gamma X_{ij} + \beta_0 + \varepsilon_{ij} \quad (1)$$

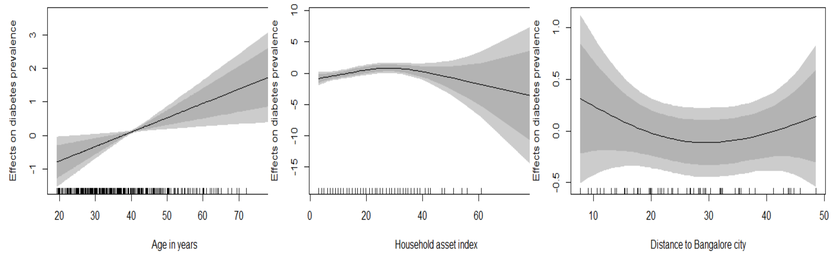
i = malnutrition indicators (Cental obesity, Diabetes)
Z = Age, education, household asset index, distance to Bangalore city, dietary diversity, frequency of meals eaten outside
γX_{ij} = linear effects of categorical covariates
β_0 and ε_{ij} are the constant and error term, respectively.

Results

Central obesity



Diabetes



Conclusion

- The factors affecting the prevalence of malnutrition, the effects seem to be beneficial at lower levels of the factor (for example, age, household assets, meals consumed outside) in consideration and with further increase in the said variables is associated with the increasing in the prevalence of malnutrition.
- This shows that nutrition and health policies targeting improving age, education, income, etc. as means/instruments should also simultaneously provide information on the potential undesirable effects of these factors when they are consumed at higher levels, particularly in regions experiencing rapid nutrition transition and NCDs.

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