Spatial Epidemiology of Child Undernutrition in Ethiopia. Evidences from EDHS 2011 data.

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Presentation outline

• Background
• Methods
• Results and Discussion
• Conclusions
**Background**

Child undernutrition is one of the major public health problems in Ethiopia.

- 28% of all child mortality is contributed by undernutrition.
- 16% of all repetitions in primary school are due to undernutrition.
- 8% of work force reductions are due to undernutrition.
- Costs 55.5 billion ETB per year (16.5% of GDP) due to undernutrition.

Background....

- In the last 15 years, Ethiopia has made significant progress in developing its:
  - Policy, strategic and program environments
  - Service delivery platforms to eliminate the problems. (EFDR 2016, FMOH 2016)

- However, the reduction progresses are very slow to achieve:
Background

• To bring sustainable solutions and meet the needs of the most vulnerable community;
  
  – Recognition of the spatial variation is very crucial.


• Understanding child undernutrition spatial variations using GIS is very important to
  ➢ Identify the most affected geographical locations
  ➢ To allocate scarce resources to the most affected areas
  ➢ To ensure equity in the community

The aim of this analysis is

• To identify the hotspot clusters of child under nutrition in Ethiopia.
Ethiopia geographical location
Methods (1)

- **Study Design:** Further secondary data analysis of EDHS 2011 (cross sectional survey).
- **Population:** Children from 0-59 months
- **Sample size:** A total 9638 children in 571 clusters were considered
- **Data Extraction:**
  - Child nutrition status indicators with ID
  - Cluster ID with GPS location were extracted
To identify primary and secondary clusters, SaTScan 9.4 software and ARC GIS, ArcMap 10.1 were used.
Methods (3)

• To identify the most likely primary cluster, Bernoulli Model SaTScan Spatial analysis was used.

• Since the number of cases in each location had Bernoulli distribution represented by 0/1 variable.

  » The model requires data with out or with a disease (0/1).

  » The location (coordinate files) of each cluster

(Kulldorff M. 2015).
Methods (4)

- Likelihood ratio test was used to test the hypothesis
  
  • “There were elevated malnourished children in side the cluster compared to outside the cluster”.
  
  • Locations with the maximum likelihood were defined as the most likely primary cluster(s).

  » It is the least likely to have occurred by chance
Ethical considerations

• A concept note was written to DHS measures
  • On importance of the further analysis
• The analysis was conducted after getting permission from DHS measures.
Results and discussion (1)

SaTScan Analysis results

Table 1. SaTScan spatial analysis of child stunting in Ethiopia from 2011 EDHS data further analysis

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Zones in the cluster</th>
<th>LLR</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All zones from Tiray, Amhara, Affar Ben. Gumz. and West and North Showa and East Wollega from Oromiya region</td>
<td>97.28</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2</td>
<td>Borena and Gedeo Zone</td>
<td>9.13</td>
<td>0.06</td>
</tr>
<tr>
<td>2</td>
<td>Guragie, Hadiya, Kemebata Alaba Yem, North omo, Jimma, Sidama and East Showa zones</td>
<td>5.67</td>
<td>0.682</td>
</tr>
<tr>
<td>2</td>
<td>Derashie</td>
<td>4.53</td>
<td>0.954</td>
</tr>
<tr>
<td>2</td>
<td>Dire Dawa</td>
<td>4.45</td>
<td>0.959</td>
</tr>
<tr>
<td>2</td>
<td>Zone 4 from Gambella</td>
<td>4.14</td>
<td>0.981</td>
</tr>
<tr>
<td>2</td>
<td>Arsi Zone</td>
<td>3.90</td>
<td>0.992</td>
</tr>
<tr>
<td>2</td>
<td>Kefich shokicho and Gambella special</td>
<td>3.71</td>
<td>0.997</td>
</tr>
</tbody>
</table>
Results and discussion (2)

• The cluster with the maximum likelihood is the most likely cluster, that is, the cluster least likely to be due to chance. *(Kulldorff. M, 2015).*

• This primary cluster for stunting, includes both drought prone and surplus producing areas.

• The secondary clusters were not significantly different from other clusters.

Fig 1. SaTScan cluster Analysis result map of child stunting
**Results and discussion (3)**

SaTScan Analysis results

Table 1. SaTScan spatial analysis of child *underweight* in Ethiopia from EDHS 2011 data further analysis

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Zones in the cluster</th>
<th>LLR</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All zones from Tigray, Amhara Ben. Gumz, and Afar and East Wolega and North Showa from Oromiya</td>
<td>60.27</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>2</td>
<td>Liben, Afder, Borena and Gode</td>
<td>13.65</td>
<td>0.001</td>
</tr>
<tr>
<td>2</td>
<td>Harar</td>
<td>10.03</td>
<td>0.024</td>
</tr>
<tr>
<td>2</td>
<td>Gurage, Hadiya and Alaba T</td>
<td>6.69</td>
<td>0.330</td>
</tr>
<tr>
<td>2</td>
<td>Derashie</td>
<td>6.61</td>
<td>0.363</td>
</tr>
<tr>
<td>2</td>
<td>Gedeo</td>
<td>6.01</td>
<td>0.874</td>
</tr>
<tr>
<td>2</td>
<td>East Harargie</td>
<td>9.21</td>
<td>0.992</td>
</tr>
</tbody>
</table>
Results and discussion (4)

SaTScan Analysis results

The primary most likely cluster for underweight includes both drought prone and surplus producing areas.

Also secondary clusters were significant for underweight.

Fig 2. SaTScan cluster Analysis of child underweight map
Results and discussion (5)
SaTScan Analysis results

Table 3. SaTScan spatial analysis of child wasting in Ethiopia from EDHS 2011 data further analysis.

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Zones in the cluster</th>
<th>LLR</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Liben, Afder and Borena</td>
<td>28.98</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>2</td>
<td>Shinile, Zone 1 and zone 4</td>
<td>24.18</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>2</td>
<td>East and West Harargie, Zone 3</td>
<td>13.68</td>
<td>0.001</td>
</tr>
<tr>
<td>2</td>
<td>Ben. Gumz special zone</td>
<td>10.77</td>
<td>0.012</td>
</tr>
<tr>
<td>2</td>
<td>Western, North and south Gondar</td>
<td>7.74</td>
<td>0.151</td>
</tr>
<tr>
<td>2</td>
<td>Eastern and Zone 4</td>
<td>6.64</td>
<td>0.37</td>
</tr>
</tbody>
</table>

11/23/2017
Results and discussion (6)

SaTScan Analysis results

- The spatial pattern of child wasting have a different pattern compared with stunting and underweight.
  - Which might be related to it is an acute measure of nutritional status and sensitive to seasonal variability.

Fig 3. SaTScan cluster Analysis of child wasting map
Conclusion

• This spatial analysis reveals that attribute of place plays an important role in shaping stunting, underweight and wasting burden distribution

  • Some areas experiencing higher burden of childhood undernutrition than others.

• Planning using aggregated national data may not help full for intervention.

• Geographical location characterization linked spatial analysis study is very important.

• Spatiotemporal analysis to see the effect interventions through time.
Conclusion

• The spatial variations have public health implications to target interventions based on vulnerability
  – Geographical targeting is important
    • Increases efficiency.
    • Allocating more resources to the risky groups
    • Has the potential to maximize program coverage.

Easy to implement
• Has low administrative costs
• Minimizes the potential for fraud
Thank you !!!!