

# The socioeconomic gradient of secondhand smoke exposure in children: Evidence from 26 low-and-middle-income countries

Mohammad Hajizadeh<sup>a</sup> Arijit Nandi<sup>b</sup>

<sup>a</sup>School of Health Administration, Dalhousie University<sup>b</sup>Institute for Health and Social Policy & Department of Epidemiology, Biostatistics, and Occupational Health, McGill University

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# Introduction

- Tobacco use is a major global health challenge that accounts for **6 million deaths** each year (10 percent of all adult deaths) (WHO 2014).
- The detrimental health effects of exposure to environmental tobacco smoke are a particularly substantial public health challenge in low-and-middle-income countries (LMICs).
- Approximately **80 per cent** of smokers live in LMICs worldwide (WHO 2014).

- **Children may be particularly vulnerable to the adverse effects of ESHS because:**
  - ① They have lesser control over their indoor environments and experience greater exposure to secondhand smoke compared to adults (US Department of Health and Human Services 2006).
  - ② They are still developing physiologically, children may be particularly sensitive to ESHS (Sleiman et al. 2010).

- ESHS increases the risk of developing several health problems in children.

## Examples

Asthma, sudden infant death syndrome (SIDS), respiratory track infections (e.g. pneumonia and bronchitis) and middle ear infections (US Department of Health and Human Services 2006).

- ESHS has also indirect effects on children's health because household expenditures on tobacco products compete with spending on food, health care, and other basic resources (Coughlin 1997).

# Introduction

- Children living in socioeconomically disadvantaged households are at higher risk of ESHS because their **parents or other household members are more likely to smoke** (Sims et al. 2010). In addition, there are **fewer smoking restrictions** in their homes (Phillips et al. 2007).

- Some recent work (e.g. Gartner & Hall 2012; Yi et al. 2012; Moore et al. 2011) has analysed socioeconomic gradients in ESHS among children in higher-income context.
- The relation between socioeconomic status (SES) and ESHS among children in LMICs, however, remains poorly understood.
  - This study, thus, aims to *first*, provide a comprehensive analysis of socioeconomic-related inequality in ESHS among children (aged 0-5) in 26 LMICs, and *second*, decompose the overall wealth-based inequality in daily ESHS in each country into inequality within and between urban and rural areas.

# Data

- 26 Demographic Health Surveys (DHSs): 2010-14
- Sample size: 313,857 children aged 0-5
- The DHS surveys collect comparable information concerning a wide range of topics, with a special focus on maternal and child health.

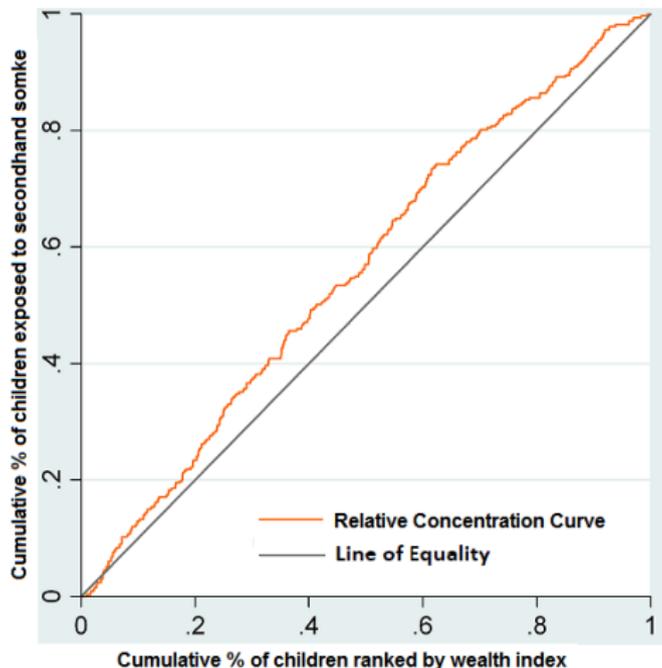
## Main Variables

- **Daily exposure to secondhand smoke (ESHS)**: it is determined using a variable in DHSs that describes frequency of household members smoke inside the house.
- **Wealth Index**: an indicator of individual-level socioeconomic status (SES)
- **GDP per capita** (PPP, current international \$) and **adult (+15) literacy rate**: indicators of country-level SES.

# The Concentration Index

- We used the concentration index approach to measure wealth-related inequalities in each country and in urban and rural areas in each country.

# The Relative Concentration index ( $RC$ )



- The index is **positive** if outcome is **concentrated among the higher SES children**, and **negative** if it is **concentrated among the lower SES children**.
- The range of the index is from -1 to +1, with a value of zero indicating "perfect equality".

# The Relative Concentration Index ( $RC$ )

- The  $RC$  index computed using the “*convenient regression*” approach suggested by Kakwani *et al.* (1997):

$$2\sigma_R^2(Y_i/\mu) = \alpha + \beta R_i + \varepsilon_i, \quad (1)$$

- where  $Y_i$  is children  $i$ 's daily ESHS,
  - $\mu$  is the mean of the daily ESHS for the total sample,
  - $R_i = i/N$  is the fractional rank of individual  $i$  in the distribution ( $i = 1$  and  $N$  for the poorest and wealthiest individual, respectively), and
  - $\sigma_R^2$  indexes the variance of fractional rank.
  - The ordinary least squares estimate of  $\beta$  represents the  $RC$ .
- As daily ESHS is binary, we normalized the  $RC$  by multiplying the calculated index by  $1/1-\mu$  (Wagstaff, 2005).

## The Absolute Concentration Index ( $AC$ )

- $AC = \mu \times RC$
- The  $AC$  ranges from  $-\mu$  to  $+\mu$ , with value *zero* indicating “perfect equality”.

## Decomposition of *RC* and *AC*

- We decomposed the RC and AC indices in order to calculate the contributions of inequality **within** and **between** urban and rural areas.

- If  $RC_{tc}$  represents the relative concentration of ESHS in the population as a whole in a country,  $c$ , it can be decomposed as (Lambert & Aronson 1993):

$$RC_{tc} = RC_{bc} + \sum_j \gamma_j RC_{jc} + R, \quad (2)$$

- where  $RC_{bc}$  is relative inequality between regions (rural-urban),
- $\gamma_j$  is the product of the region  $j$ 's share of the daily ESHS and its share of the total population,
- $RC_{jc}$  is the relative concentration of daily ESHS in the region  $j$ , and
- $R$  is a reranking term.

- Decomposition of the normalized  $RC_{tc}$ :

$$RC_{tc}/1-\mu = RC_{bc}/1-\mu + \sum_j \gamma_j RC_{jc}/1-\mu + R/1-\mu, \quad (3)$$

- Decomposition of the normalized  $AC_{tc}$ :

$$AC_{tc}/1-\mu = AC_{bc}/1-\mu + \sum_j \gamma_j AC_{jc}/1-\mu + \mu R/1-\mu, \quad (4)$$



## Descriptive Results

- In the majority of countries more than 20 per cent of children aged 0-5 were exposed to second-hand smoke on a daily basis at home.
- While in countries such as Honduras, Tajikistan and Ethiopia less than 10 per cent of children were exposed to secondhand smoke, this figure was greater than 60 per cent in Indonesia, Jordan and Armenia.
- Children's daily ESHS was higher in rural areas compared to urban areas in the majority of the countries.

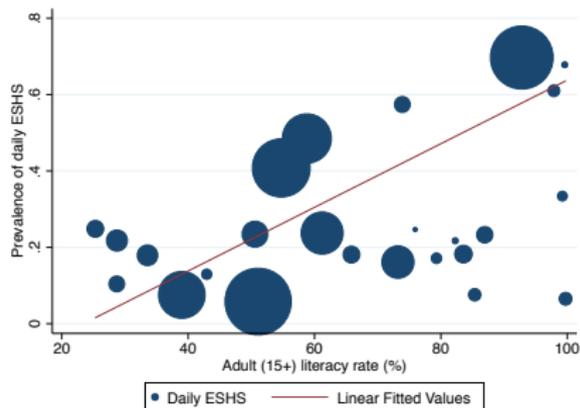
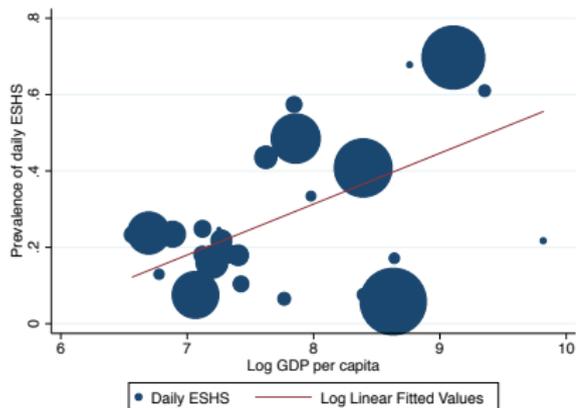
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# Cross-country correlations country level socioeconomic indicators and daily ESHS



## Socioeconomic inequalities in daily ESHS

- The estimated RC and AC demonstrated that daily ESHS was concentrated among poorer children in almost all countries (RC, median=-0.174 and AC, median=-0.037).
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## RC and AC indices for daily ESHS prevalence in 26 LMICs

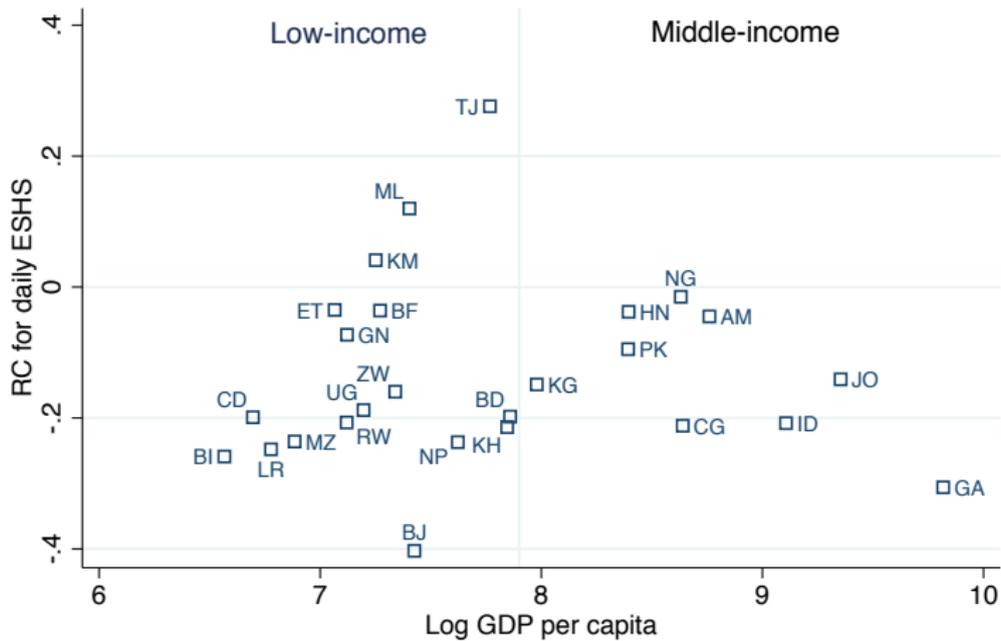
Country (Code)	RC	AC
<b>Low-income</b>		
<i>Bangladesh (BD)</i>	-0.198 (-0.222 to -0.174)	-0.096 (-0.108 to -0.084)
<i>Benin (BJ)</i>	-0.403 (-0.428 to -0.377)	-0.042 (-0.045 to -0.039)
<i>Burkina Faso (BF)</i>	-0.036 (-0.06 to -0.012)	-0.008 (-0.013 to -0.003)
<i>Burundi (BI)</i>	-0.259 (-0.287 to -0.23)	-0.06 (-0.067 to -0.054)
<i>Cambodia (KH)</i>	-0.214 (-0.241 to -0.186)	-0.123 (-0.139 to -0.107)
<i>Comoros (KM)</i>	0.041 (-0.01 to 0.091)	0.01 (-0.002 to 0.022)
<i>Congo DR (CD)</i>	-0.199 (-0.222 to -0.177)	-0.047 (-0.053 to -0.042)
<i>Ethiopia (ET)</i>	-0.035 (-0.088 to 0.017)	-0.003 (-0.007 to 0.001)
<i>Guinea (GN)</i>	-0.073 (-0.105 to -0.04)	-0.018 (-0.026 to -0.01)
<i>Liberia (LR)</i>	-0.248 (-0.293 to -0.202)	-0.032 (-0.038 to -0.026)
<i>Mali (ML)</i>	<b>0.12 (0.091 to 0.149)</b>	<b>0.022 (0.016 to 0.027)</b>
<i>Mozambique (MZ)</i>	-0.236 (-0.262 to -0.211)	-0.055 (-0.061 to -0.049)
<i>Nepal (NP)</i>	-0.237 (-0.27 to -0.204)	-0.103 (-0.118 to -0.089)
<i>Rwanda (RW)</i>	-0.207 (-0.234 to -0.18)	-0.038 (-0.042 to -0.033)

## RC and AC indices for daily ESHS prevalence in 26 LMICs (cont.)

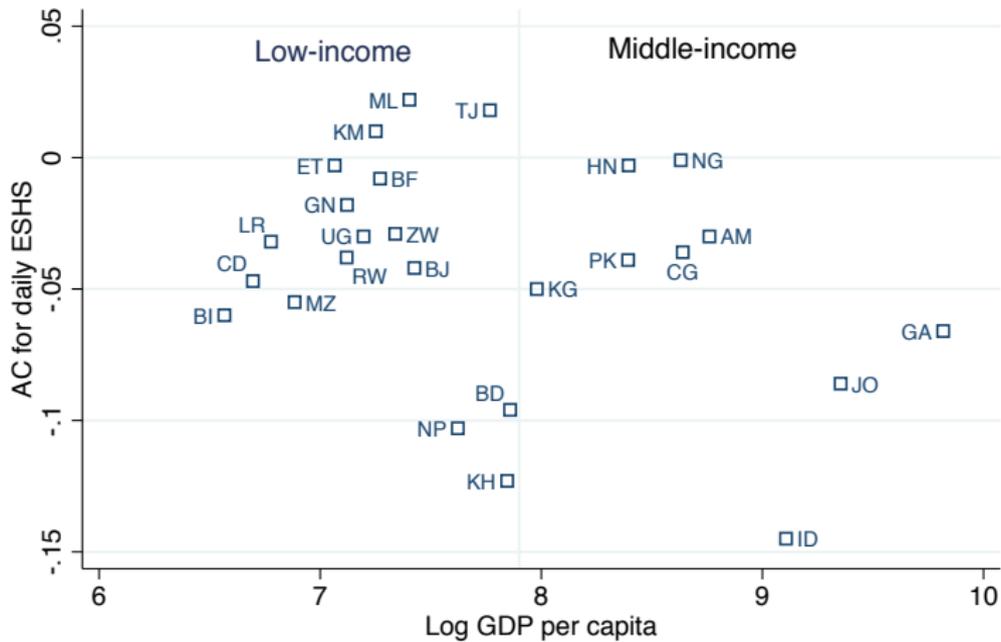
Country (Code)	RC	AC
<i>Tajikistan (TJ)</i>	0.276 (0.216 to 0.336)	0.018 (0.014 to 0.022)
<i>Uganda (UG)</i>	-0.188 (-0.221 to -0.154)	-0.03 (-0.036 to -0.025)
<i>Zimbabwe (ZW)</i>	-0.16 (-0.196 to -0.124)	-0.029 (-0.036 to -0.023)
<b>Middle-income</b>		
<i>Armenia (AM)</i>	-0.045 (-0.118 to 0.029)	-0.03 (-0.08 to 0.02)
<i>Congo Braz. (CG)</i>	-0.212 (-0.252 to -0.172)	-0.036 (-0.043 to -0.03)
<i>Gabon (GA)</i>	-0.306 (-0.363 to -0.249)	-0.066 (-0.079 to -0.054)
<i>Honduras (HN)</i>	-0.038 (-0.082 to 0.006)	-0.003 (-0.006 to 0.00)
<i>Indonesia (ID)</i>	-0.208 (-0.233 to -0.183)	-0.145 (-0.163 to -0.127)
<i>Jordan (JO)</i>	-0.141 (-0.179 to -0.103)	-0.086 (-0.109 to -0.063)
<i>Kyrgyz Repub. (KG)</i>	-0.149 (-0.187 to -0.111)	-0.05 (-0.062 to -0.037)
<i>Nigeria (NG)</i>	-0.015 (-0.044 to 0.015)	-0.001 (-0.003 to 0.001)
<i>Pakistan (PK)</i>	-0.095 (-0.121 to -0.069)	-0.039 (-0.05 to -0.028)

Notes: 95% confidence intervals in parentheses.

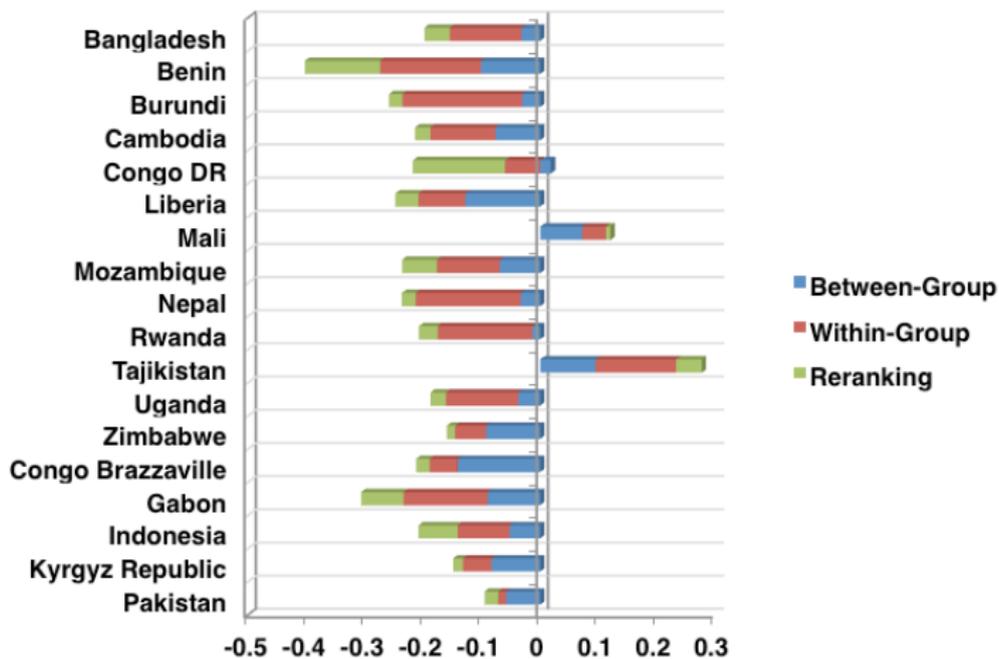
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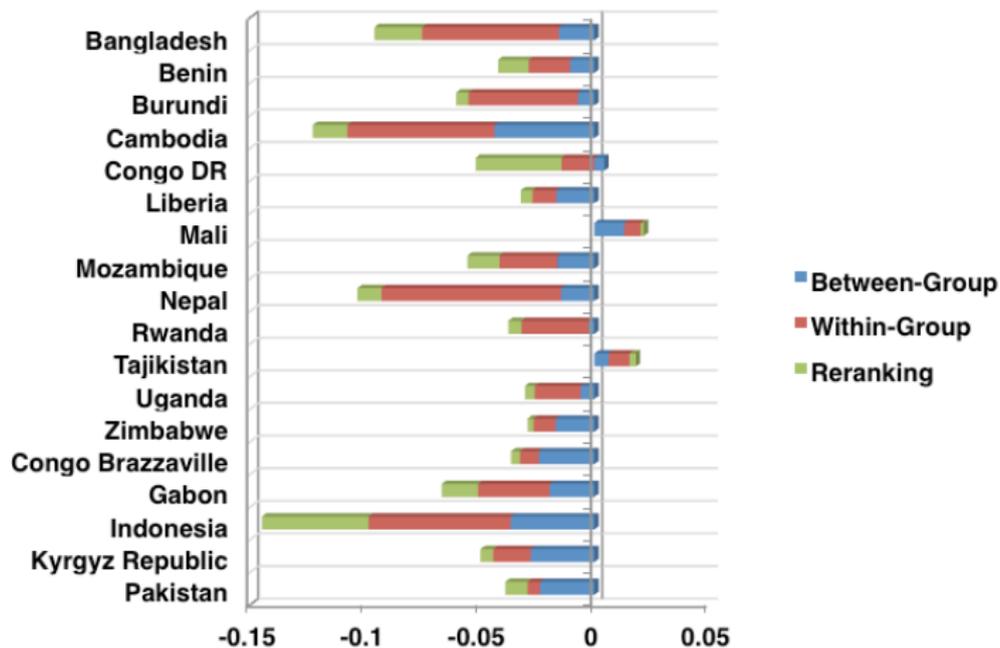
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# Decomposition of relative inequalities in daily ESHS in LMICs



# Decomposition of absolute inequalities in daily ESHS in LMICs



## Percentage contributions of the three components to the overall RC/AC

Country	Between-Group	Within-Group	Reranking
<b>Low-income</b>			
Bangladesh	16%	62%	22%
Benin	25%	43%	32%
Burundi	12%	79%	9%
Cambodia	35%	52%	12%
Congo DR	-9%	30%	79%
Liberia	52%	32%	16%
Mali	60%	34%	6%
Mozambique	29%	46%	25%
Nepal	14%	76%	10%
Rwanda	7%	78%	15%
Tajikistan	34%	50%	16%
Uganda	20%	66%	14%
Zimbabwe	58%	33%	9%

## Percentage contributions of the three components to the overall RC/AC

Country	Between-Group	Within-Group	Reranking
<b>Middle-income</b>			
Congo Brazzaville	67%	23%	11%
Gabon	29%	47%	24%
Indonesia	25%	43%	32%
Kyrgyz Republic	56%	33%	11%
Pakistan	61%	14%	25%
Median	29%	44%	16%

- ① We found negative socioeconomic gradient in all but two countries – Mali and Tajikistan – of the 26 LMICs.
- ② The concentration of ESHS among the poor children was greater in urban compared to rural areas.
- ③ The decomposition analysis suggest that:
  - Within areas inequality is the main determinant of socioeconomic inequality at the national level in most of the countries (median=44 per cent).
  - The median contribution of inequality of daily ESHS between areas to the overall measures of socioeconomic inequality was 29 per cent.

- ① Self-reported measure of daily ESHS could be an issue in our analysis if under-reporting was associated with SES.
- ② As ESHS is bounded, the minimum and maximum of the RC (AC) are not  $-\mu$  (-1) and  $\mu$  (1). There was much lively debate as to how to overcome this issue in health economics literature (e.g. Wagstaff 2009, Erreygers 2009, Kjellsson & Gerdtham 2013a; Kjellsson & Gerdtham 2013b; Allanson & Petrie 2013).

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# Conclusion

- **Children** from rural and socioeconomically disadvantaged households (particularly those living in urban areas) **are more likely to experience daily ESHS at home.**
- Thus, special attention should be devoted to address ESHS among these groups because socioeconomic disparities in ESHS might lead to socioeconomic disparities in tobacco-related health problems among the children over the life-course.

# Conclusion

- Children from rural and socioeconomically disadvantaged households (particularly those living in urban areas) are more likely to experience daily ESHS at home.
- Thus, special attention should be devoted to address ESHS among these groups because socioeconomic disparities in ESHS might lead to socioeconomic disparities in tobacco-related health problems among the children over the life-course.