

# Effects of a Stressful Environment (SE) on Height, BMI and Menarche Age

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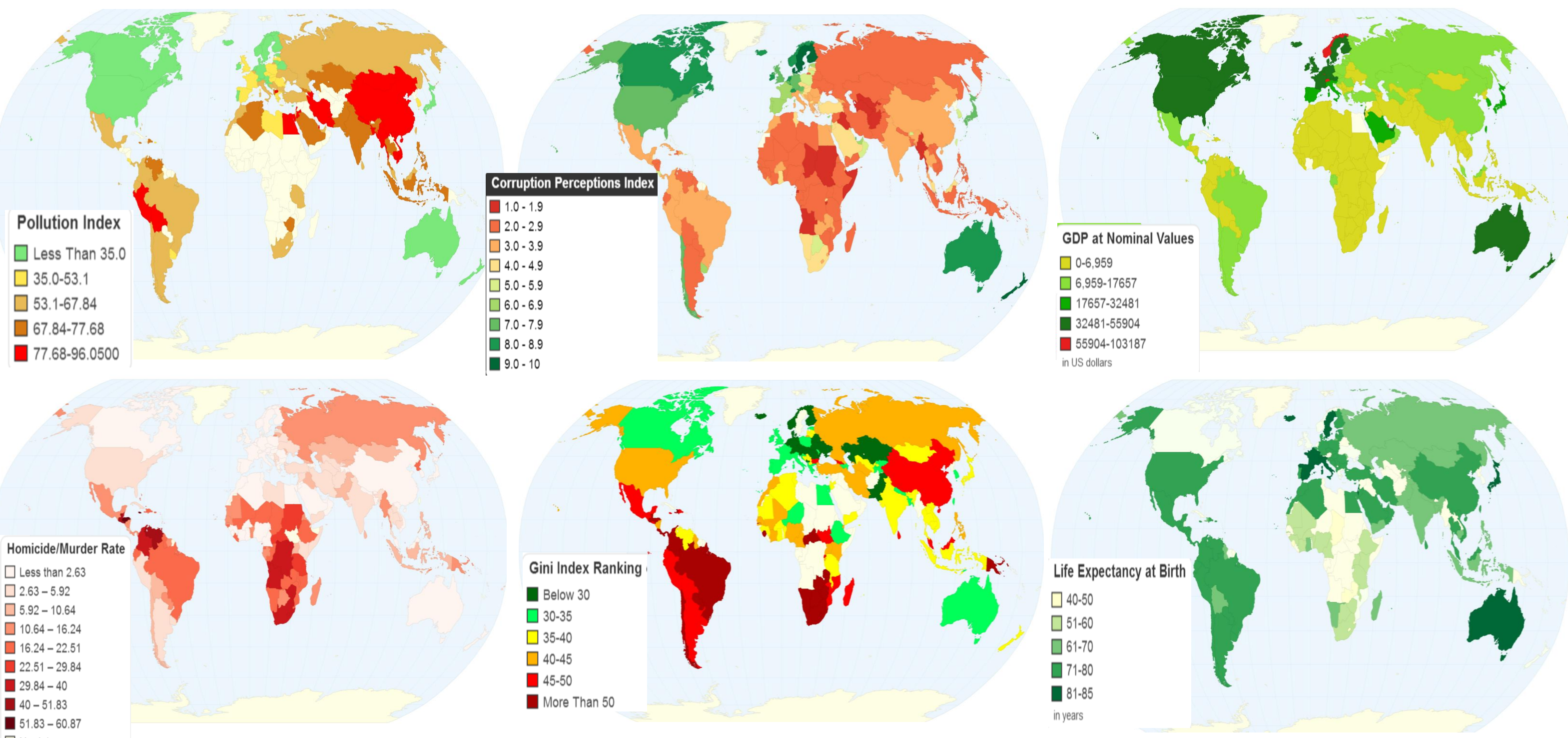
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## BACKGROUND

- Growth is highly adaptable, both genetically over the long-term and by short-term plasticity. Differences in height can reflect adaptations to different environments at individual and population levels.
- Growth in height is considered an indicator of health and well-being of an individual and a population, especially in developing countries.
- SE is a major problem globally, and children are exposed to various kinds of SE in different countries.
- Children's exposure to stress predicts poor health, but its effects on growth are understudied, while poor growth is another predictor of poor health.

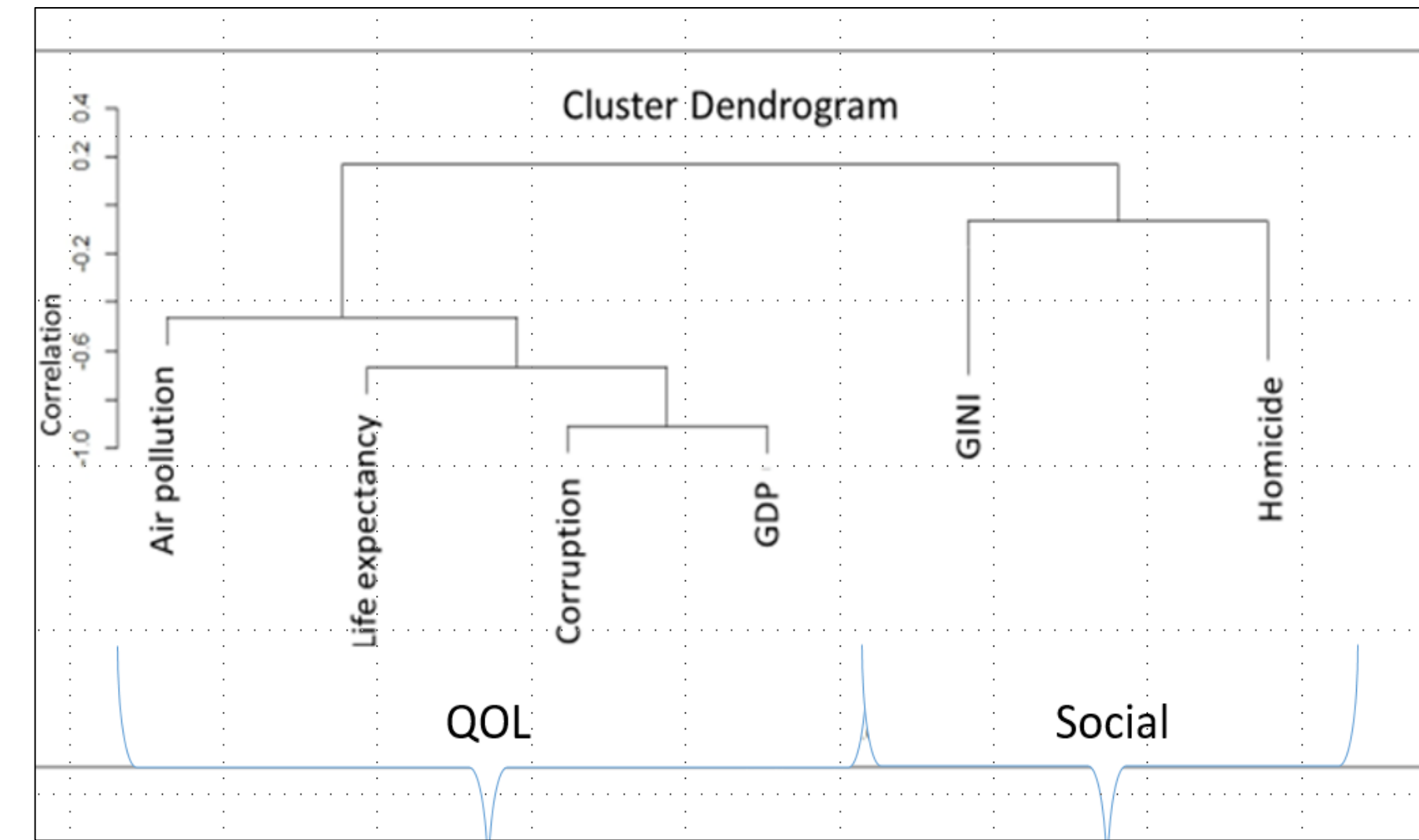
## METHODS

- Data by country of height, BMI, menarche in 1996-2005 were collected from WHO reports and scientific articles.
- Countries were ranked and scored for their SE in 1990-2000, built on seven indicators (World Databank, Transparency International):
  - annual homicide rates
  - GDP per capita U\$ (on a purchasing-power-parity basis)
  - income inequality (Gini coefficient)
  - corruption perception
  - Unemployment
  - urban air pollution (weighted concentration for PM2.5 pollutants)
  - life expectancy at birth (years).
- Z-transformation was done to the SE indicators.
- Only countries with data available for height, BMI, menarche, and all seven SE indicators were included to a total of 71 countries.



## RESULTS

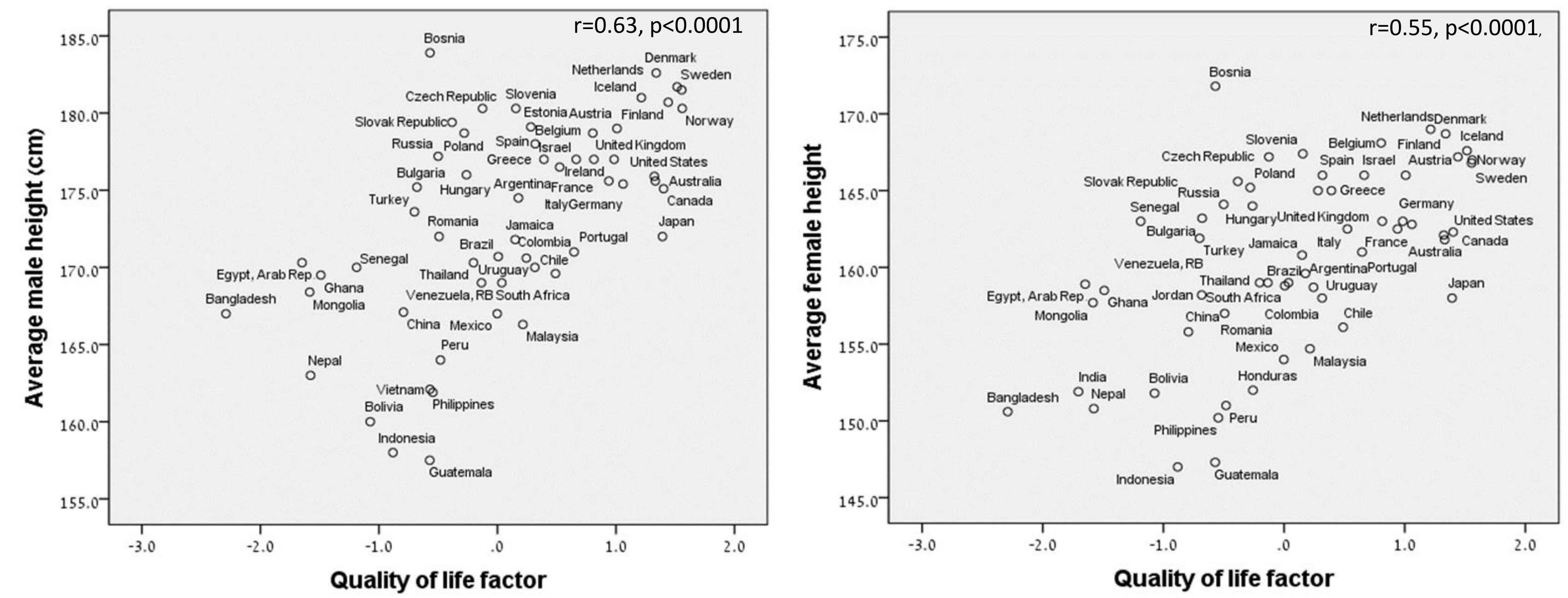
### PCA clustered SE indicators into 2 components unemployment was excluded by the PCA



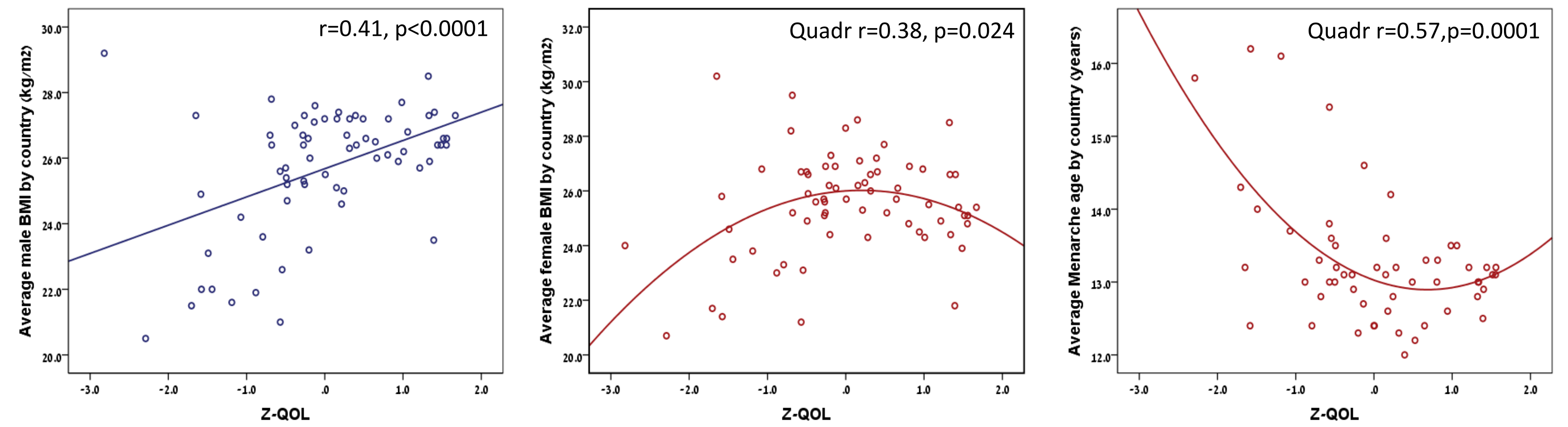
**Component Matrix<sup>a</sup>**

	Component 1	Component 2
Corruption	.903	.138
GDP	.895	.094
Life expectancy	.818	.220
Air pollution	.618	.593
Homicide	-.516	.709
Inequity	-.558	.696

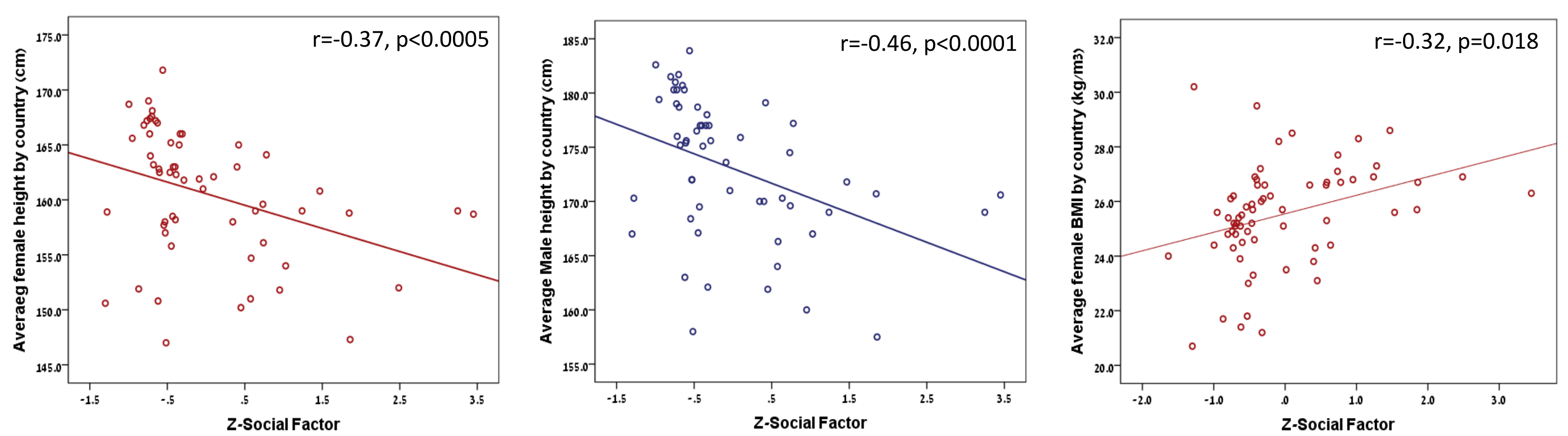
### QoL indicators correlated with average country male/female height



### QoL indicator correlated with male/female BMI & menarche age



### Social indicators correlated with male/female height, BMI & menarche age



## RESULTS

### Correlation coefficients R between stress indicators and male and female height, BMI, menarche age, \*\* p<0.01

	GDP	Life expectancy	Air pollution	Unemployment	Corruption	Inequality	Homicide
Male height	0.56**	0.32**	0.52**	-0.37**	0.56**	0.58**	0.22
Female height	0.52**	0.28**	0.43**	-0.33**	0.52**	0.55**	0.26
Male BMI	0.70**	0.56**	0.24	-0.25**	0.35**	0.48**	0.25**
Female BMI	0.45**	0.39**	0.013	-0.40**	-0.11	0.14	-0.13
Menarche age	-0.56**	-0.38**	-0.26	0.17	-0.33**	-0.15	-0.076

## CONCLUSIONS

- Young adult height, as a measure of child's growth, is a strong indicator of SE.
- BMI is a weaker indicator.
- Male's height is affected by SE more than female's height.
- Female's BMI and menarche show a U-shape response to stress; delayed menarche and lower BMI are found in the lowest and highest SE countries.
- The strongest indicators for poor growth is the QOL cluster (pollution, life expectancy, GDP and corruption), followed by the Social cluster (homicide and economic inequality).

## PERSPECTIVE

Comparing SE across countries, we identified leverage points to reducing vulnerability to SE to social and emotional stress. Identification of particularly vulnerable nations or regions can act as an entry point for both understanding and addressing the processes that cause and exacerbate vulnerability.