Traffic accident mortality rates in Africa: Police data or models' estimates?

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WHO statistics for Africa

Reported number of road traffic deaths

- National data coordinator
- Police data
  - On the scene mainly
  - 30 days « officially »
  - Reviewed by Road safety agency committee
- Adjusted for 30-day definition of a road traffic death

Modelled number of road traffic deaths

- For countries with death registration data (Ministry of Health, International Classification of deseases 9th or 10th revision) at least 80% complete
- Predicted from three Negative binomial models
  - fitted on 85 countries (completeness at 80% or more)
  - On the number of deaths (2013)
    - Death registration data calculated with redistribution of « undetermined intent » and adjusted for incompleteness
    - Projected from previous death registration data
    - Reported deaths (Police)

Togo 640/1044/2123 en 2013

Economic Commission for Europe Intersecretariat Working Group on Transport Statistics. *Glossary of transport statistics, 3rd ed. New* York, NY, United Nations Economic and Social Council, 2003 (TRANS/WP.6/2003/6).

The negative binomial regression model on a pseudo-panel (2000-2013)

- Countries : **Egypt (projected), South Africa (reported)**

Argentina, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Barbados, Belarus, Belgium, Belize, Brazil, Bulgaria, Canada, Chile, China *(14, 15)*, Colombia, Costa Rica, Croatia, Cuba, Cyprus, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Fiji, Finland, France, Georgia, Germany, Greece, Guatemala, Guyana, Hungary, Iceland, Ireland, Israel, Italy, Jamaica, Japan, Kazakhstan, Kuwait, Kyrgyzstan, Latvia, Lithuania, Luxembourg, Maldives, Malta, Mauritius, Mexico, Montenegro, Netherlands, New Zealand, Norway, Oman, Panama, Paraguay, Philippines, Poland, Portugal, Qatar, Republic of Korea, Republic of Moldova, Romania, Russian Federation, Saint Lucia, Serbia, Singapore, Slovakia, Slovenia, South Africa, Spain, Suriname, Sweden, Switzerland, The former Yugoslav Republic of Macedonia, Trinidad and Tobago, Turkey, United Kingdom, United States of America, Uruguay, Uzbekistan, West Bank and Gaza Strip

- $\text{LogE}(N_{it}) = \text{Log}(Pop_{it}) + a + \Sigma bX_{it}$

Variables

- Motorised
- Asphalt/earth

- Problems
  - Domain of variations
  - Correlation
  - Mixtures of fatal accidents (catastrophic)
  - No time trend (decreasing)
  - Constant

Independent variables	Description	Source of information	Included in models
ln(GDP)	WHO estimates of Gross Domestic Product (GDP) per capita (international dollars or purchasing power parity dollars, 2011 base)	WHO database	Models A, B, C
ln(vehicles per capita)	Total vehicles per 1000 persons	GSRRS surveys and WHO database	Models A, B, C
Road density	Total roads (km) per 1000 hectares	International Futures database *(11)*	Models A, B, C
National speed limits on rural roads	The maximum national speed limits on rural roads (km/h) from WHO questionnaire	GSRRS survey	Models A, B, C
National speed limits on urban roads	The maximum national speed limits on urban roads (km/h) from WHO questionnaire	GSRRS survey	Models A, B, C
Health system access	Health system access variable (principal component score based on a set of coverage indicators for each country)	Institute for Health Metrics and Evaluation dataset *(12)*	Models A, B, C
Alcohol apparent consumption	Liters of alcohol (recorded plus unrecorded) per adult aged 15+	WHO database	Models A, B, C
Population working	Proportion of population aged 15–64 years	World Population Prospects 2012 revision (UNDESA)	Models A, B, C
Percentage motorbikes	Per cent of total vehicles that are motorbikes	GSRRS survey	Model B
Corruption index	Control of corruption index (units range from about -2.5 to +2.5 with higher values corresponding to better control of corruption	World Bank (13), International Futures database *(11)*	Model B
National policies for walking / cycling	Existence of national policies that encourage walking and / or cycling	GSRRS survey	Model C
Population	Total population (used as offset in negative binomial regression)	World Population Prospects 2012 revision (UNDESA) *(6)*	Models A, B, C

GBD models

- Data mining (prediction) rather than statistical modelling (explanation)
- Method CODEm Cause of Death Ensemble model = prediction as combination of algorithms
  - Linear mixed effects model
  - Spatial-temporal model (Gaussian process regression)
  - choice of covariates

$$\ln\left(rate_{s,r,c,y,a}\right) = \beta_i X_{i_{s,r,c,y,a}} + \beta_a d + \pi_s + \pi_{s,r} + \pi_{s,r,a} + \pi_{s,r,a,c} + \varepsilon_{s,r,c,y,a}$$

$$\text{logit}\left(cause\,fraction_{s,r,c,y,a}\right) = \beta_i X_{i_{s,r,c,y,a}} + \beta_a d + \pi_s + \pi_{s,r} + \pi_{s,r,a} + \pi_{s,r,a,c} + \varepsilon_{s,r,c,y,a}$$

Where:
s = super-region index; r = region index; c = country index; y = year index; a = age index

Panel data and model for sub-saharan Africa (2001-2010)

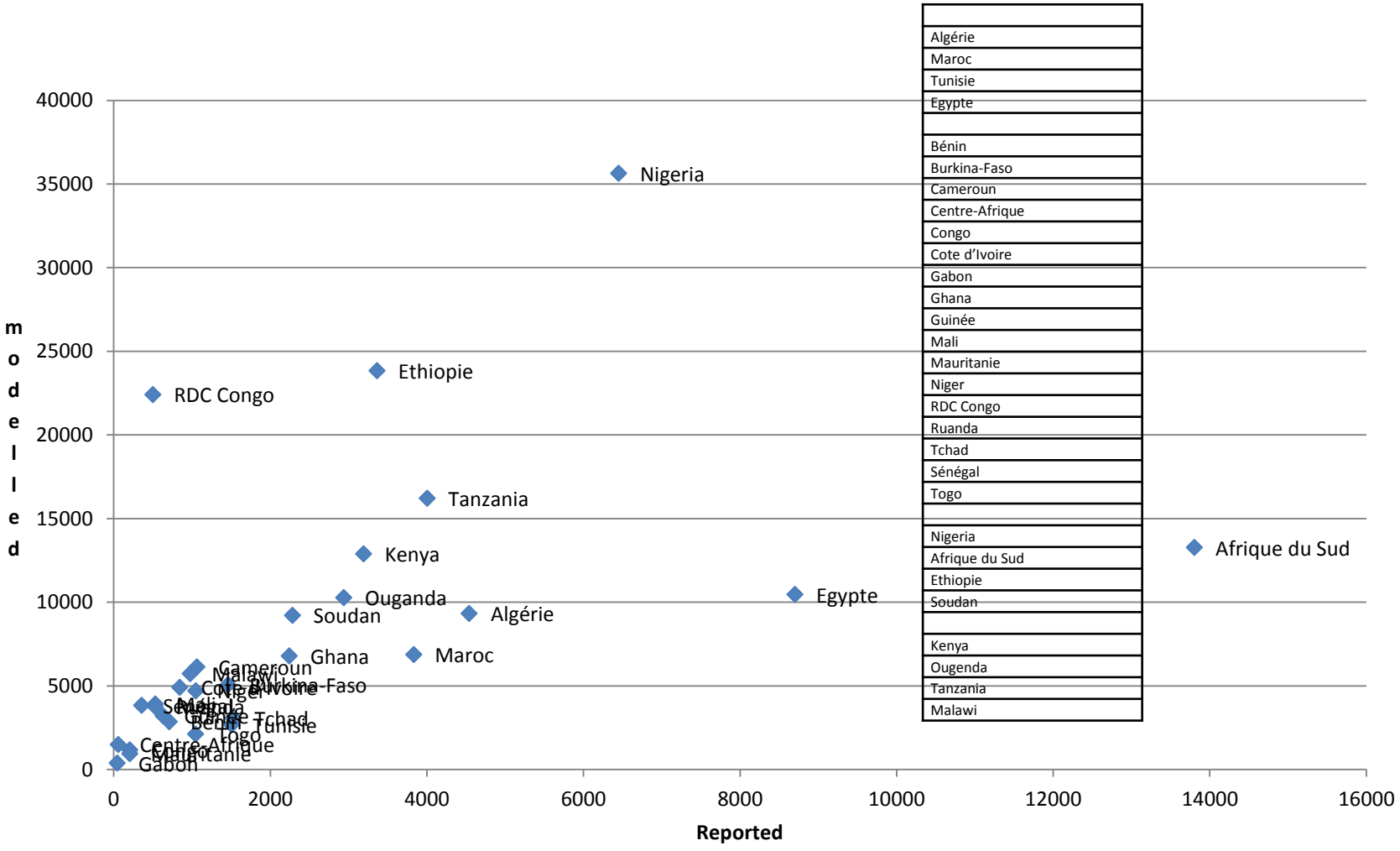
Eq. (1) represents the RE panel structure of a regression model having a dependent variable y_{it} referring to the road mortality rate of country i at time t, a normally distributed disturbance term ε_{it} and k regressors $x_{1it}, \ldots, x_{kit}$ for $i = 1, \ldots, N$ and $t = 1, \ldots, T$.

$$y_{it} = \alpha + \beta_1 x_{1it} + \ldots + \beta_k x_{kit} + u_i + \varepsilon_{it} \quad (1)$$

Non-panel estimation results for t

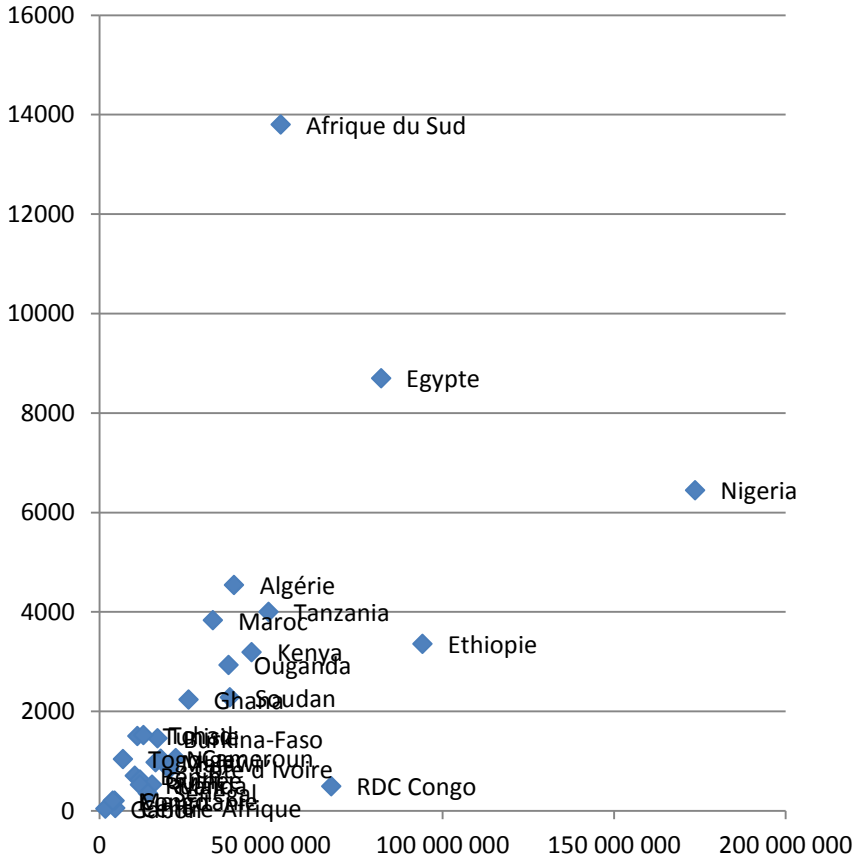
Regressors	Model 1 - OLS
	Parameter
GDPPC	0.002** (2.62)
POP64	1.200** (3.12)
ROADNET	−2e−05*
	(−1.73)
EXPECT	−0.162
	(−1.60)
EPHONE	−1.261
	(−1.21)
EAMB	−0.018
	(−0.64)
EDOC	−0.738
	(−0.50)
ENUR	2.266 (1.37)
YEAR	−0.477**
	(−3.49)
CONSTANT	909.932**
	(3.31)
σ^2	
R-squared	0.770
AIC	1272.168
DIC	
Countries	23
Observations	230

Comparison reported/modelled

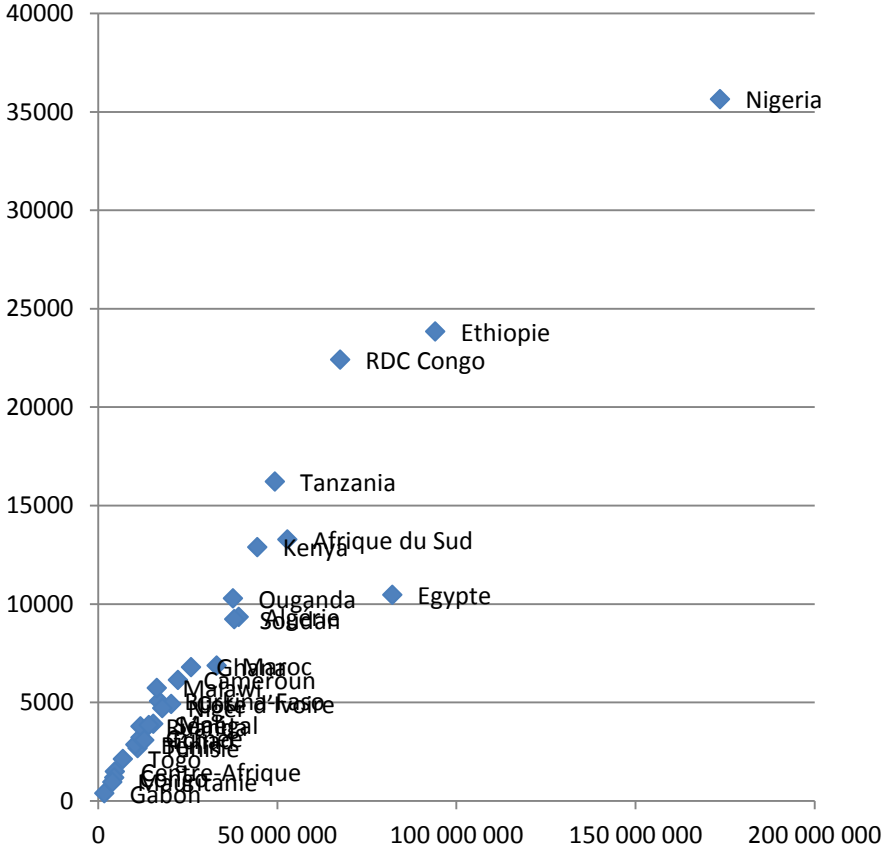


Comparison

Reported/population

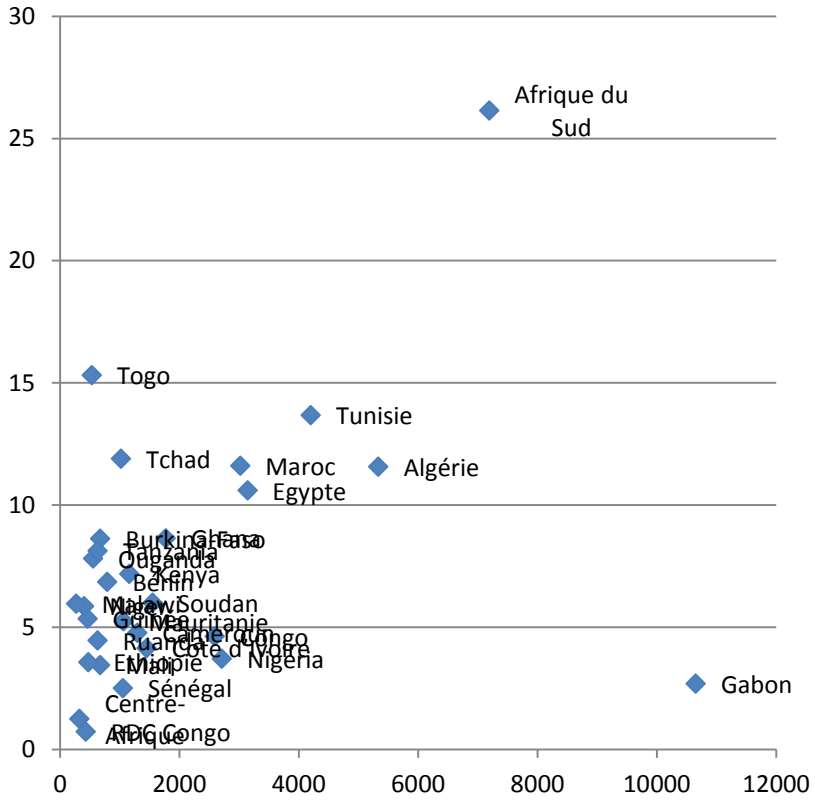


Modelled/Population

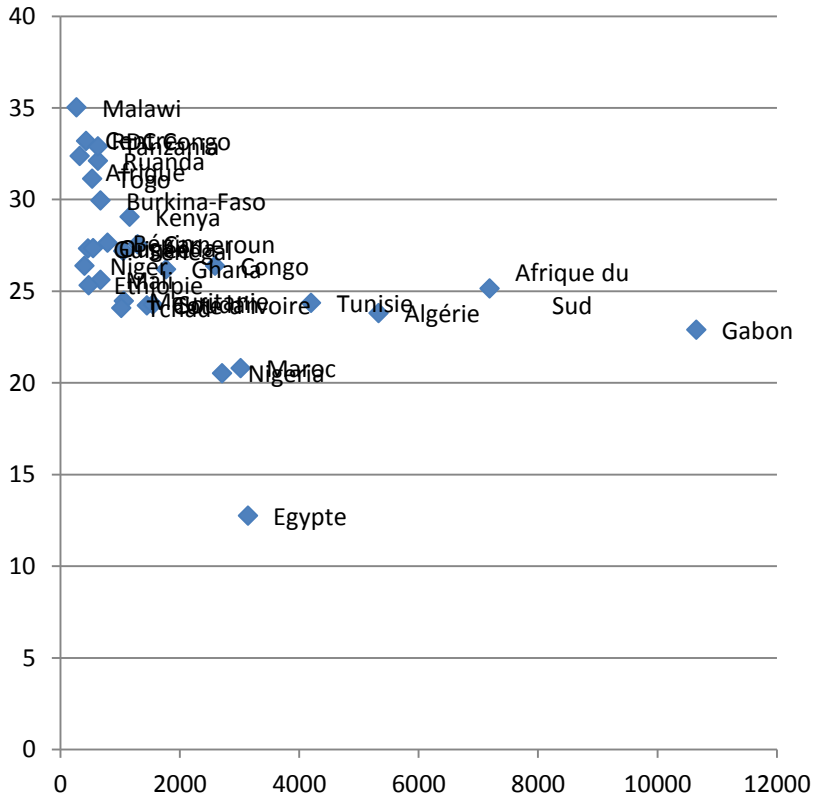


Egypt 8701/10466
SouthAfrica 13802/13273

Reported mortality rate/GDP



Modelled mortality rate/GDP



Police data in sub-saharan Africa

- Colonial print : Gendarmerie et Police
  - Constat d'accident matériel et corporel par agents des forces de l'ordre
  - Couverture territoriale (sauf guerre)
- Deux filières
  - Remontée rapide hiérarchique des brigades à la direction générale
    - Plus fiable Gendarmerie/Police
    - Tué sur le coup
  - Le BAAC opérationnel dans les années 80, puis en désuétude, revival dans les années 2000/10
- Statistiques officielles revues en commission multipartite (Transport, Santé, Police) par l'agence de sécurité routière

Correction du sous-enregistrement

- Possible territorialement, facile à corriger
- Pour les tués, ajouter
  - Les blessés décédés pendant le transport (sapeur-pompiers)
  - Les blessés décédés au service d'urgence (hopitaux)
  - Les blessés décédés à l'hopital,
  - Les perdus de vue

Conclusion

- Faible qualité des modèles de régression sans prise en compte du trend temporel séculaire et des effets pays (OMS)
  - Extrapolation hasardeuse de pays hors Afrique vers les pays africains
- Non transparence des modèles d'ensemble (GBD)
- Dans les pays sub-sahariens, cohérence des données Gendarmerie/Police en remontée rapide avec une limitation aux tués sur le coup. Correction possible à partir des données des services de sécurité civile et des hôpitaux.

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