# Neuroepidemiological issues in Africa
## *(sub-saharan Africa)*

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**Inserm UMR 1094**
**Limoges, France**

- ü Africa: a huge continent
- ü Methodological challenges
- ü Global burden of diseases
- ü Focus on some diseases
- ü Conclusion

# The African continent

*World's second-largest and second-most-populous continent*

Area: 54 countries in 30 221 532 $km^2$

Population:

1,075,615,883 (15% of World population)

829,000,000 in 48 Sub-Saharan countries

42 % < 15 yrs old

Life expectancy: 53 yrs

Infantile mortality rate: 85 ‰

Economy: GNP per capita: $ 100 to 5,000 (RSA)

(vs $ 65,000 Luxembourg)

# *Focus on sub-saharan Africa*

## Environment

- specific climate (tropical or sub-)
- resource-poor è poor sanitation/hygiene/housing
- specific environmental factors *(infections…)*

## Means

- low access to health care with inequalities in geographic distribution
- poverty: limited health means
- low number of trained staff

## Population

- specific sociocultural factors
- young with low life expectancy
- rapid, uncontrolled growth of urban centers
- inadequate health/sanitation facilities

## “Political” issues

- rare stability
- few specific programs for neurological diseases
- health policy issues

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# Methodological challenges

Definition of the population
Migrations
Sampling strategy: availability of census…
Validity of demographic data? (age…)
Refusals or subjects impossible to join

⇒ some solutions

- cluster sampling
- official documents…or specific methods *(age: time milestones)*
- sensitization of the local authorities and population
- well defined procedures +++

# Methodological challenges

Ascertainment of cases
Difficulties in follow-up
Lack of trained specialists
Lack of neuroimaging devices (MRI, CT scan)
Operational difficulties
Ethnic diversity à many dialects and behaviours
Stigma…and then “hidden” cases?

⇒ some solutions

- use of multiple sources of information ( ± capture-recapture)
- use of standardized tools and definitions
- trained interviewers and interpreters
- make profit of demographic surveillance systems

# Neuro Staff and means of diagnosis

## One Neurologist for

250,000 people in the North and South (RSA)

600,000 to 6,000,000 people in the intertropical zone

## Means of diagnosis

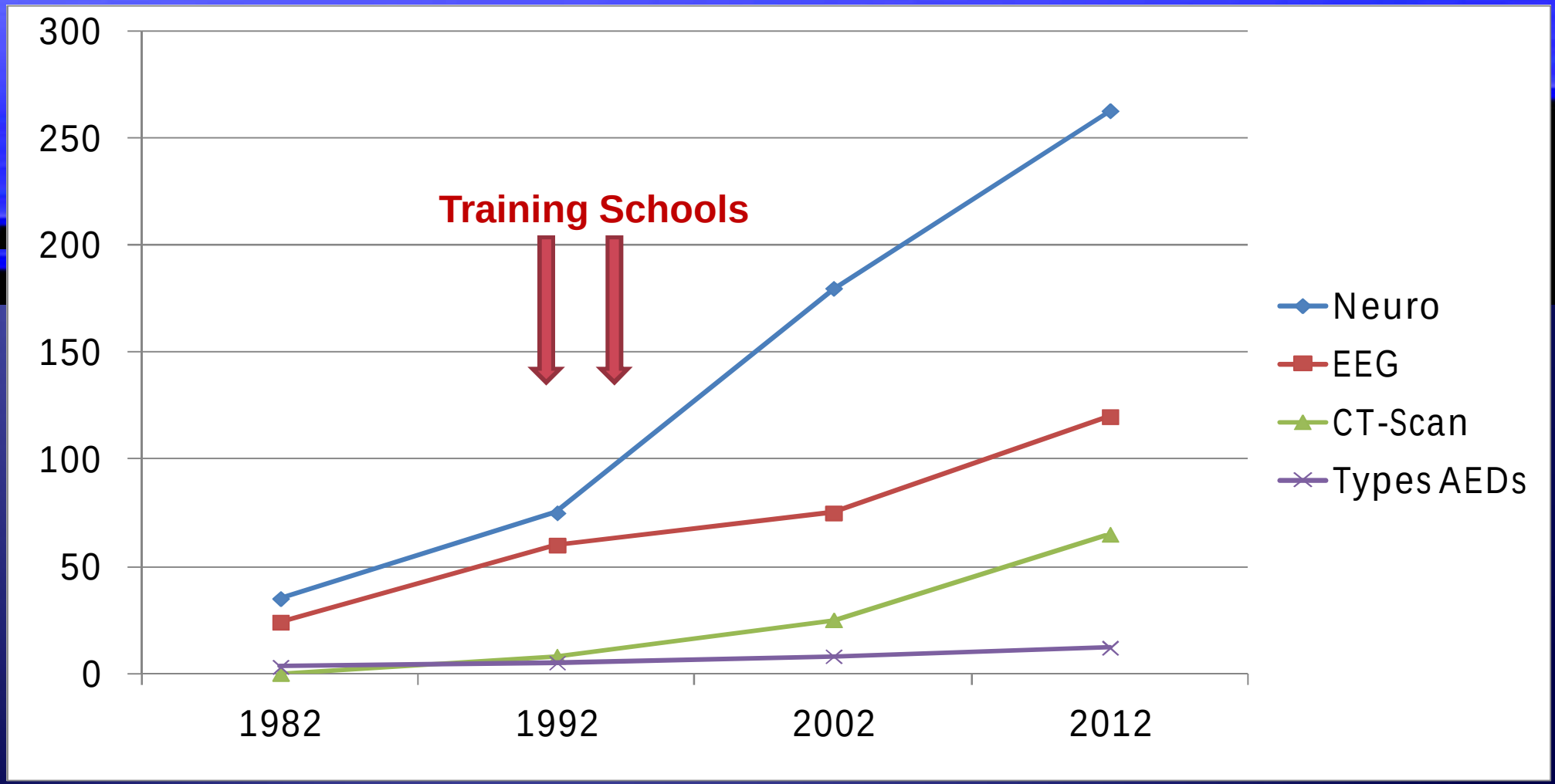
>200 EEG; >200 CT: for 205,000,000 North inhabitants

>150 EEG; >250 CT: for 60,000,000 South Afr. inhabitants

100-120 EEG; 70 CT: for 800,000,000 intertropical zone

Very limited number of MRI

# Evolution of Neuro-Staff, EEG and AEDs 1982-2012 in Sub-Saharan Africa (excl. Maghreb and RSA)



# Languages

In total, **3000 languages** are spoken in Africa

but 12 languages spoken by 75% of Africans

**86 ethnic groups** (with population > 10 million) in Africa

è *Importance of good translations and back-translations of the tools*

***http://www.saylor.org/site/wp-content/uploads/2011/04/Ethnic-groups-in-Africa.pdf***

*Regardless of the difficulties, standards of methodology should be applied everywhere*

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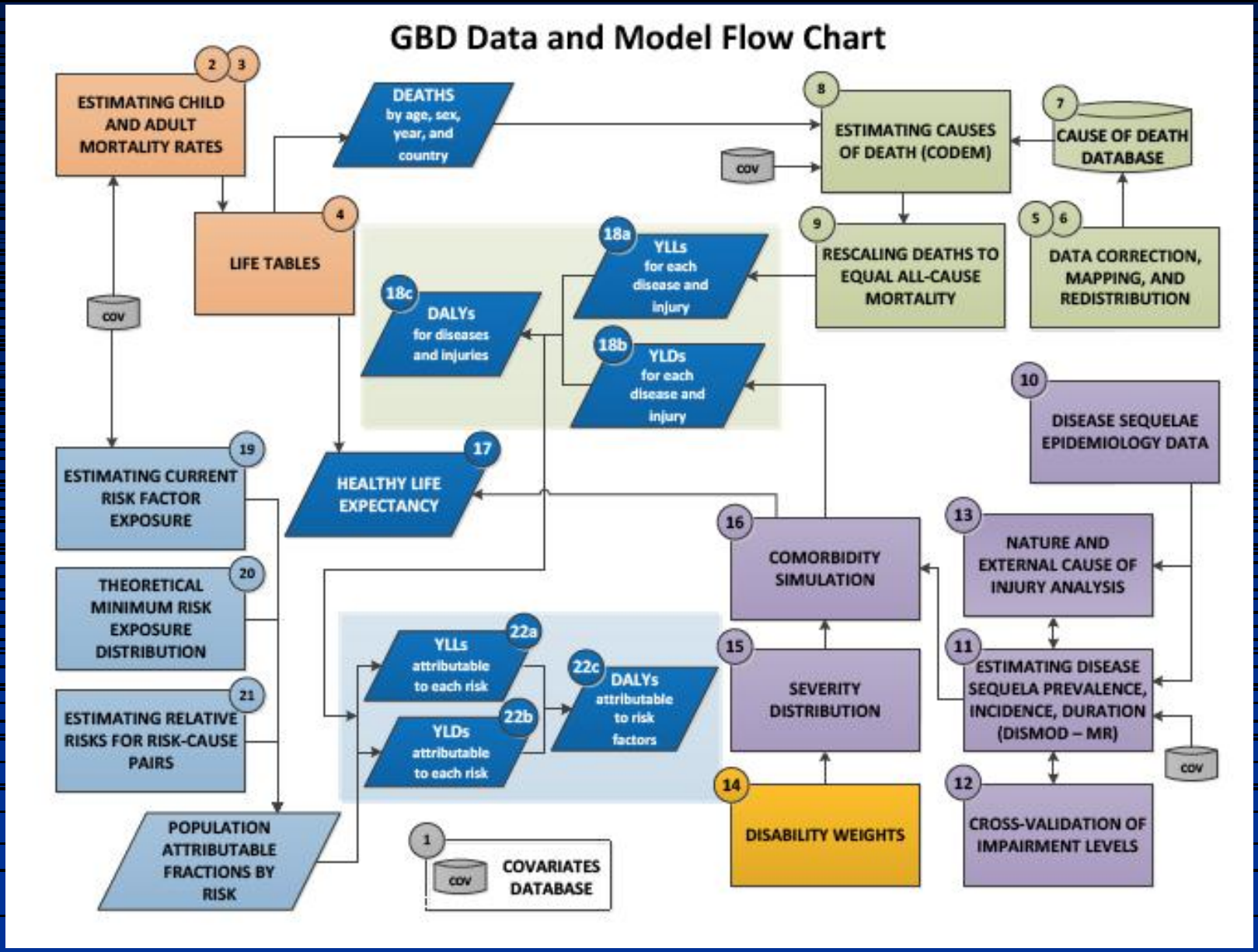
# THE GLOBAL BURDEN OF DISEASE: GENERATING EVIDENCE, GUIDING POLICY

## SUB-SAHARAN AFRICA REGIONAL EDITION

INSTITUTE FOR HEALTH METRICS AND EVALUATION
UNIVERSITY OF WASHINGTON

HUMAN DEVELOPMENT NETWORK
THE WORLD BANK

http://www.healthmetricsandevaluation.org/gbd/publications/policy-reports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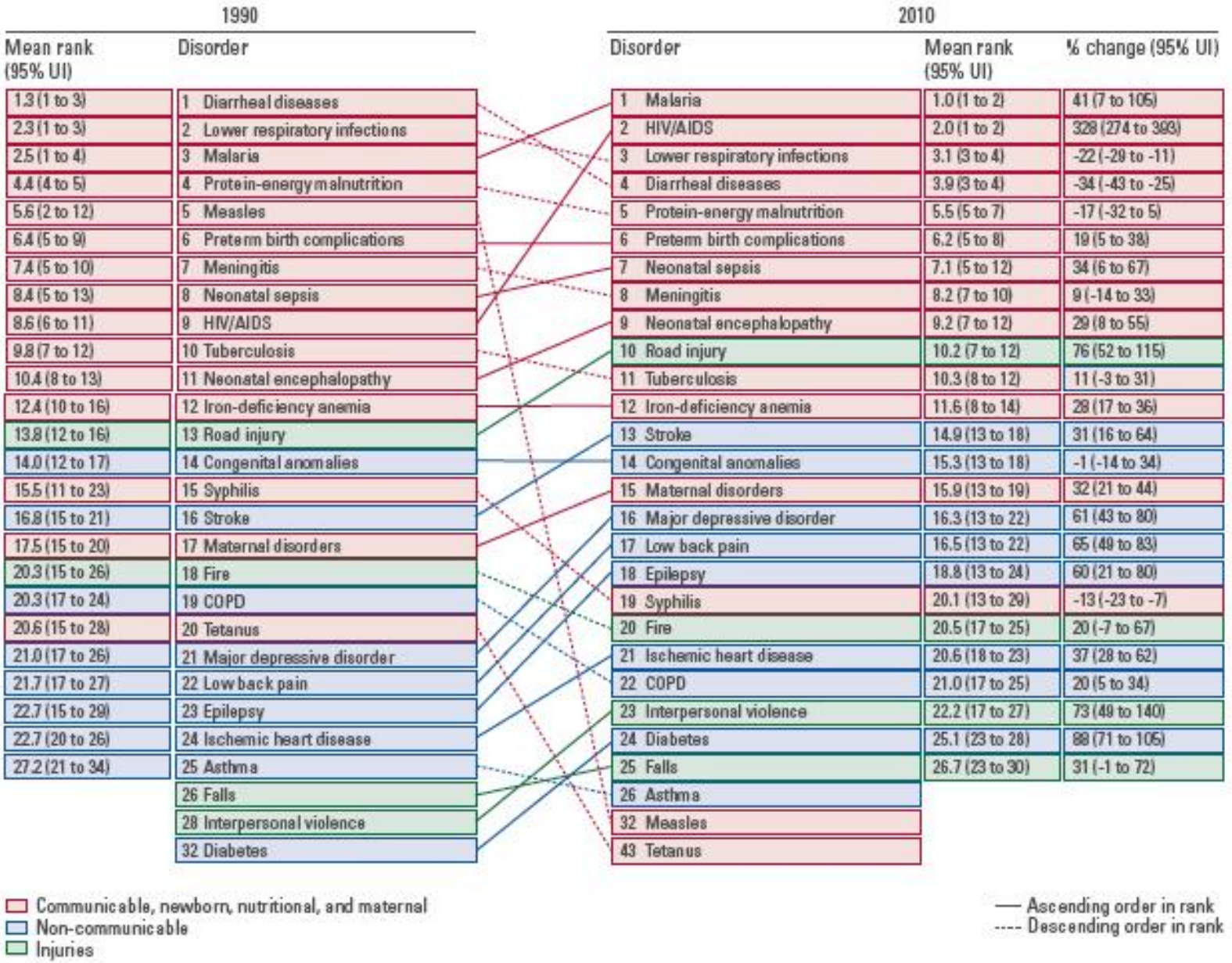
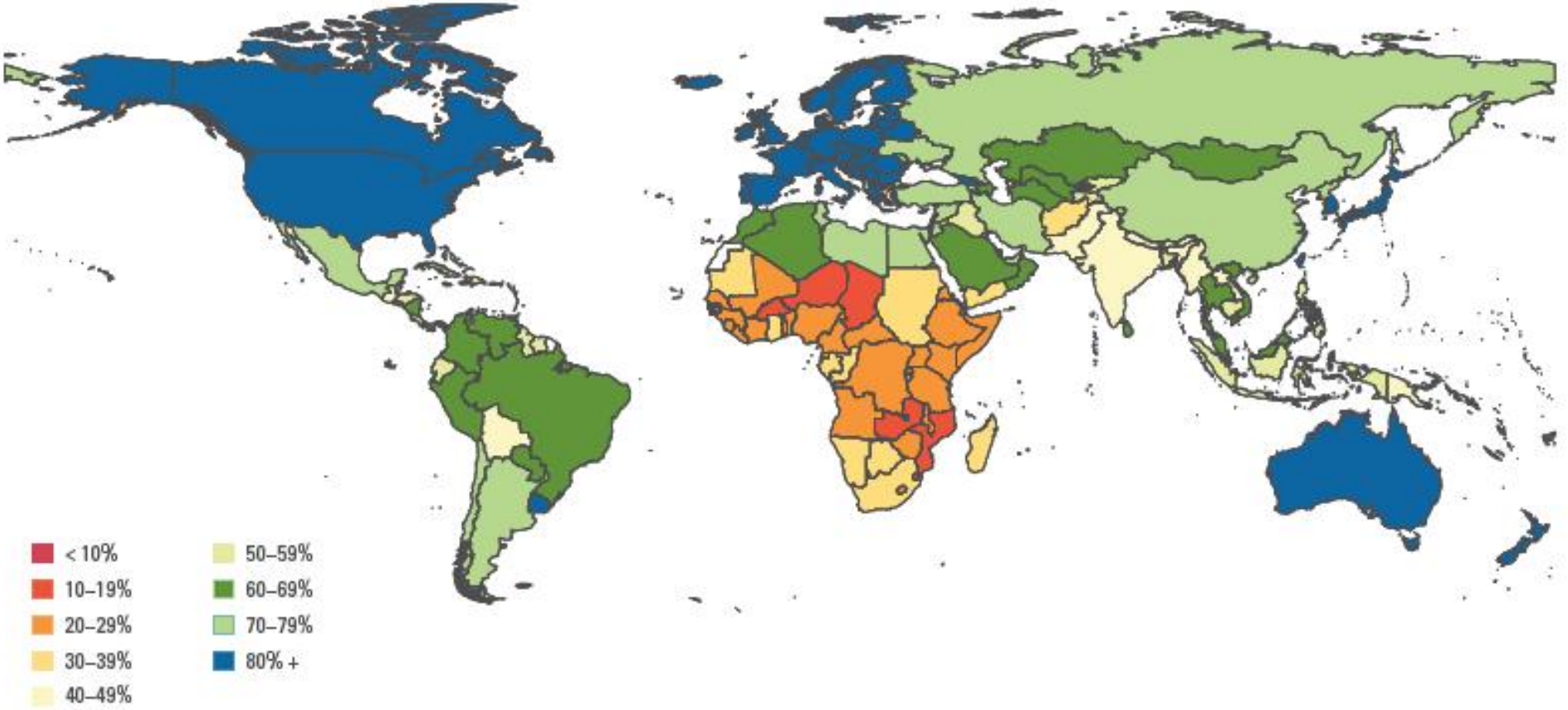
# DALY, GBD, 2010

**Figure 2: Disability-adjusted life year ranks, top 25 causes, and percentage change in sub-Saharan Africa, 1990-2010**

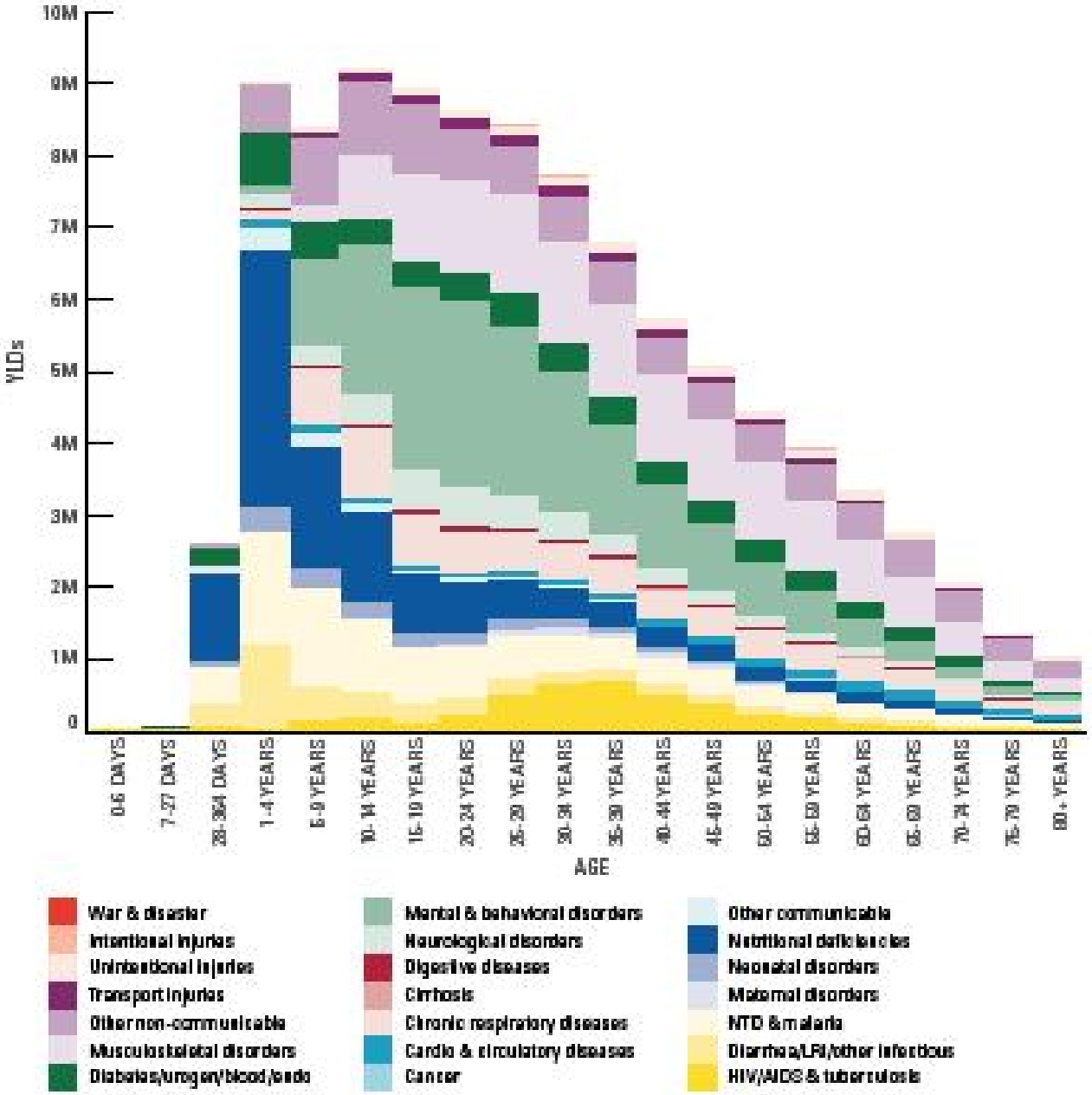


# Percentage of DALY due to NCD, GBD 2010



# DALY, GBD, 2010

Figure 14: Disability patterns by broad cause group and age in sub-Saharan Africa, 2010



# DALY, GBD, 2010

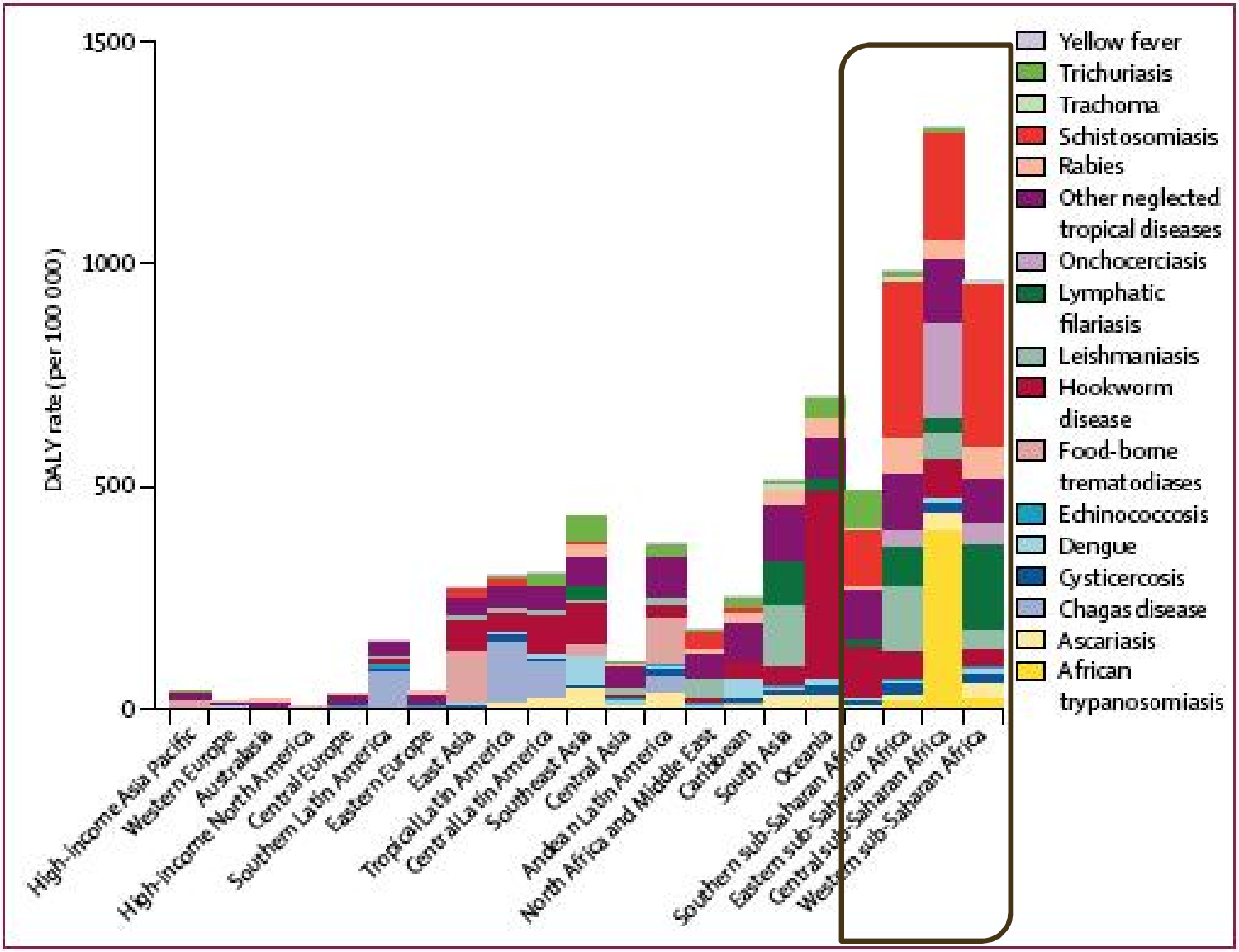
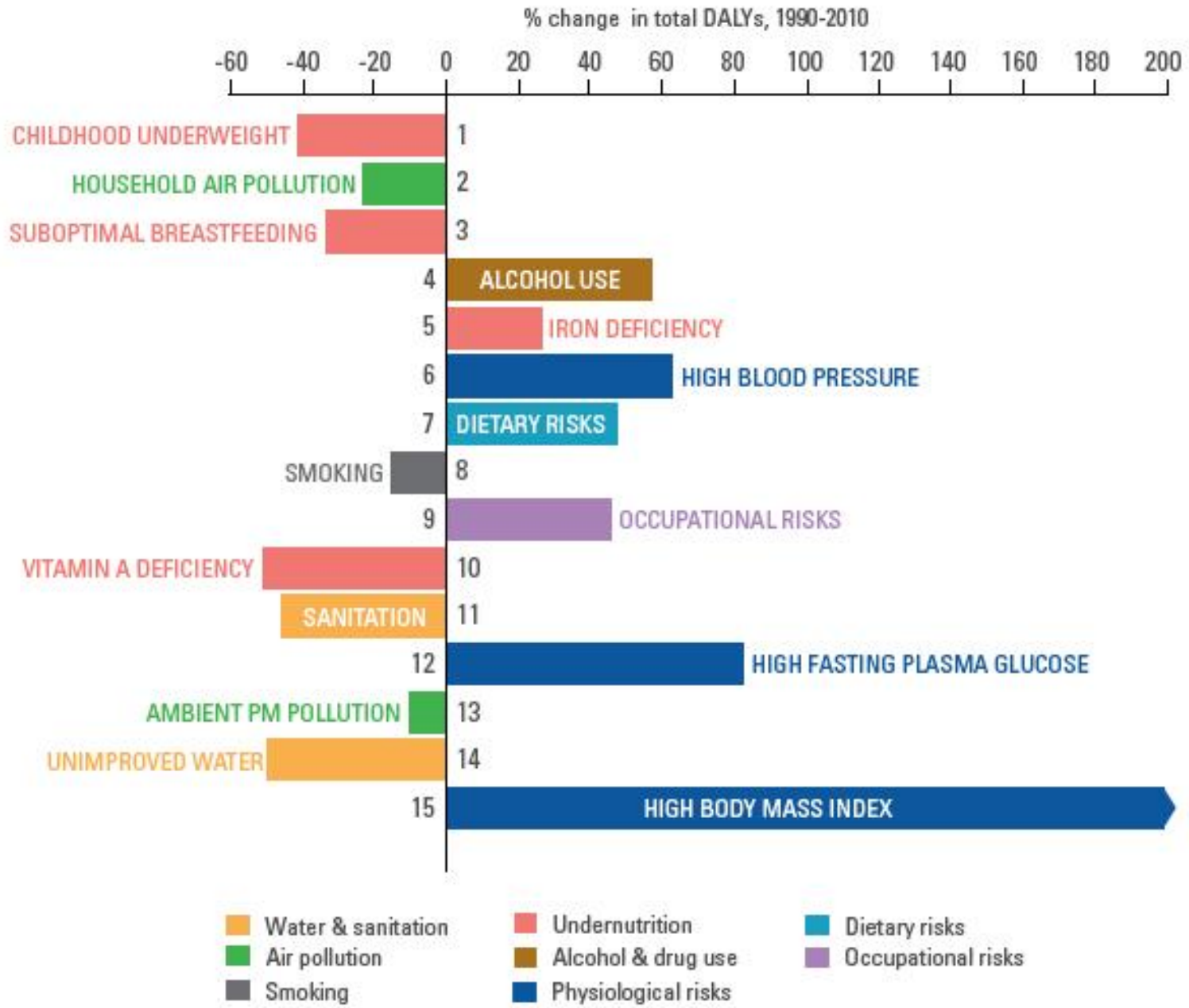



*Figure 9:* **Neglected tropical disease disability-adjusted life year rates by cause and region in 2010**
This figure excludes malaria.

*Murray et al., 2012*

# DALY, GBD, 2010

**Figure 17: Shifts in rankings of DALYs in sub-Saharan Africa for top 15 risk factors, 1990-2010**



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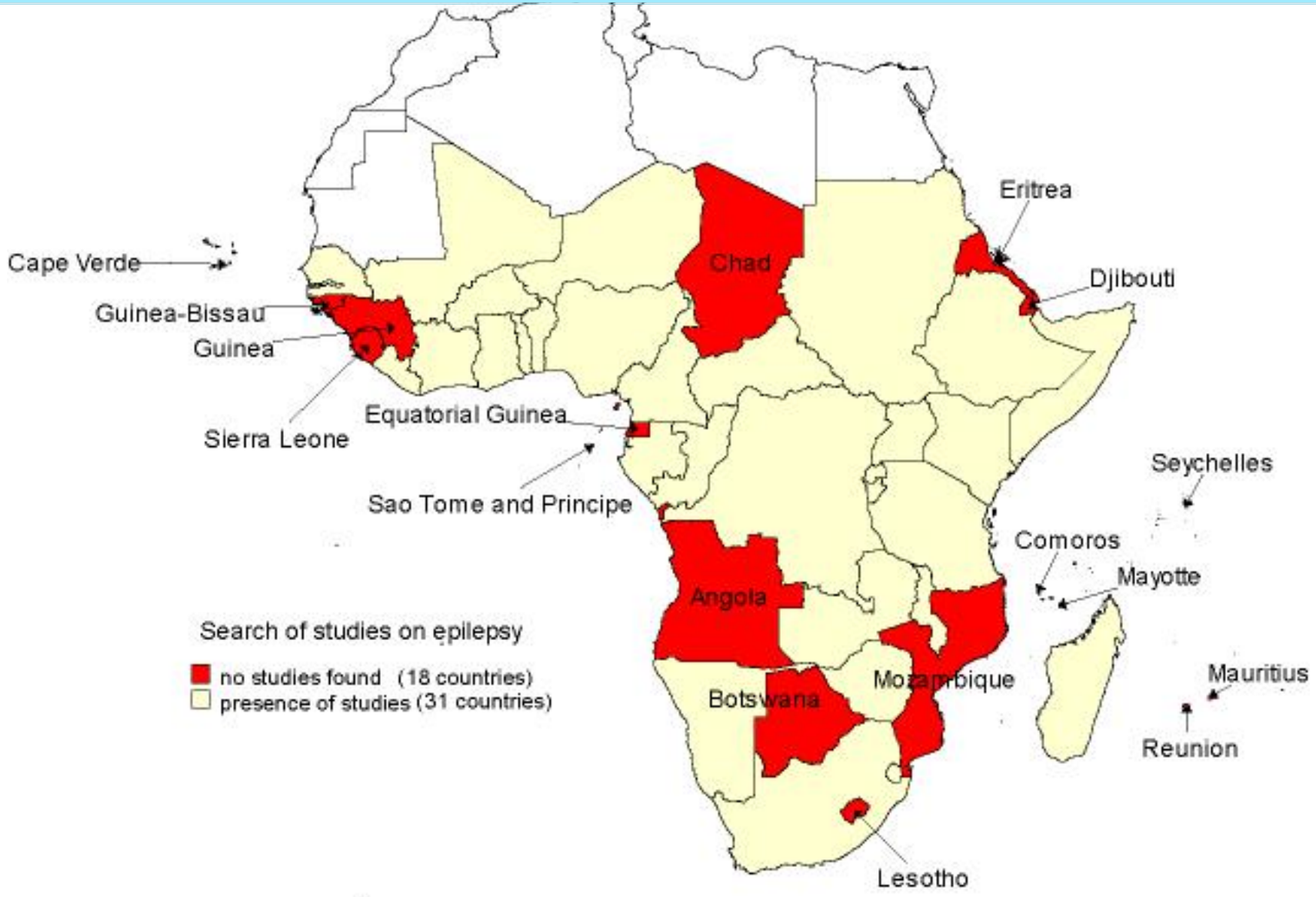
# RECENT REVIEW OF EPILEPSY IN SUB-SAHARAN AFRICA



## No publication found in 18 (36%) countries!

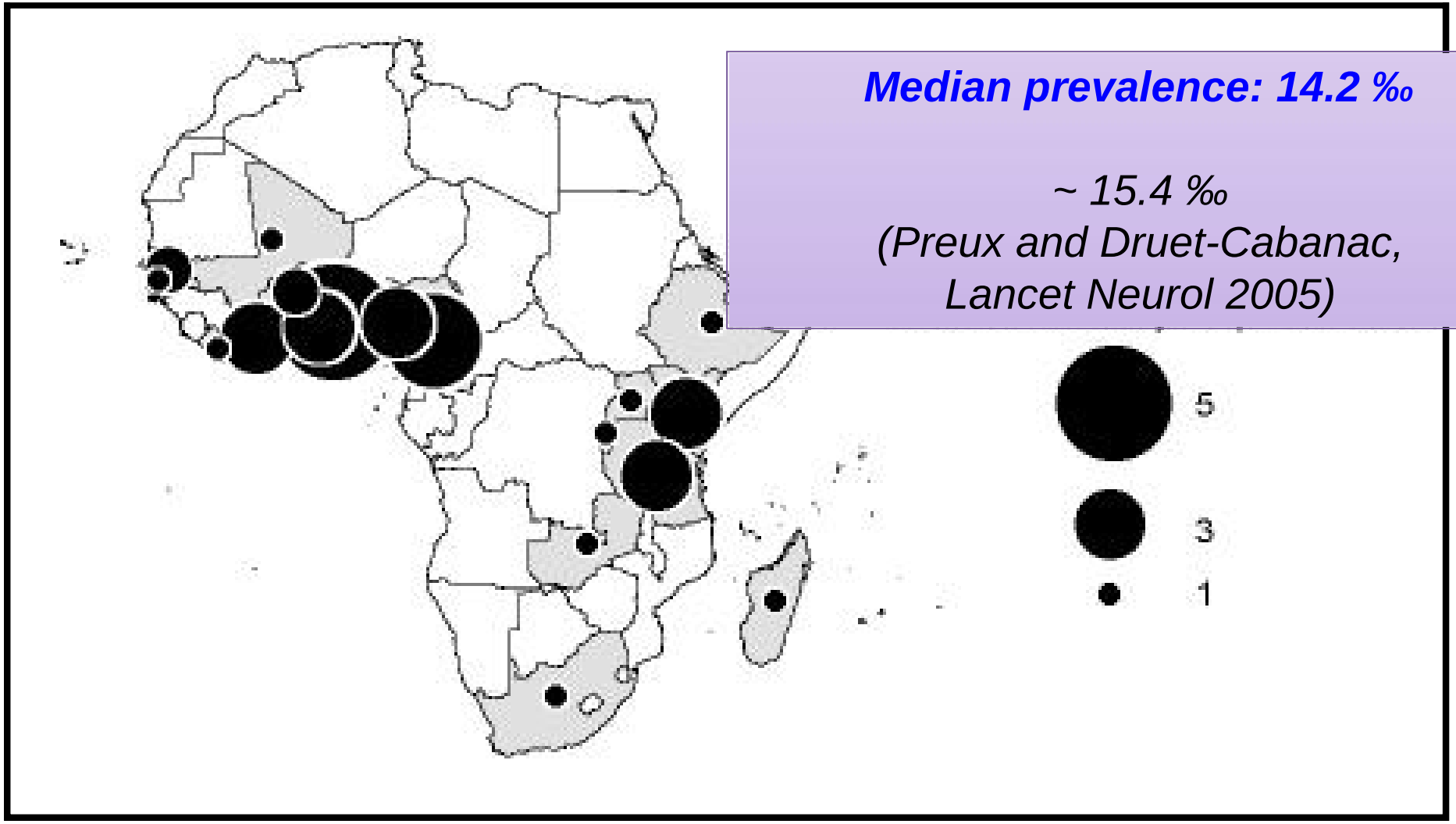



***Awa Ba Diop & PM Preux, personal data***

# RECENT REVIEW OF EPILEPSY IN SUB-SAHARAN AFRICA

Number of study on epilepsy prevalence in Sub-Saharan Africa

***Prevalence:*** *38 studies*




***Median prevalence: 14.2 ‰***

*~ 15.4 ‰*
*(Preux and Druet-Cabanac, Lancet Neurol 2005)*

***Awa Ba Diop & PM Preux, personal data***

Annual incidence (per 100 000)

only 7 estimates published in 6 countries

| | |
|---|---|
| Ethiopia | 64.0 (1997) |
| Benin | 69.4 (2012) |
| Tanzania | 73.3 (1992) |
| Tanzania | 81.0 (2009) |
| Burkina Faso | 83.0 (1993) |
| Uganda | 156.0 (1998) |
| Kenya | 187.0 (2008) |

***Awa Ba Diop & PM Preux, personal data***

# Risk factors

Very few well-conducted analytical studies exist, in particular case-control studies or (historical) cohort studies…

Problems: only prevalence cases, not representative, too few controls, no neuroimaging, all the potential risk factors not studied, no information on the latency between the first acute symptomatic seizure and the onset of epilepsy …

| Countries | Year | N Epilepsy cases | N Controls | Multivariate analysis | OR Febrile seizures | OR familial history | OR head trauma | OR perinatal disorder | OR prior infection | OR Parasitosis onchocerciasis | OR Parasitosis cysticercosis |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Nigeria | 1989 | 155 | 155 | No | 11.0 | | 13.0 | | | | |
| Burundi | 1997 | 103 | 72 | No | | | | | | | 4.6 |
| Burundi | 1997 | 110 | 82 | No | | | | | | 1.4 | |
| CAR | 1999 | 187 | 374 | No | | | | | | NS | NS |
| Mali | 2000 | 70 | 140 | No | | | | | | NS | NS |
| Tanzania | 2001 | 174 | 174 | Yes | 2.9 | 3.6 | | 4.5 | 3.8 | | |
| Burundi | 2003 | 324 | 648 | Yes | | 3.3 | | 1.9 | | | 4.1 |

*Case-control studies in subsaharan Africa; OR: odds ratio; NS: factor studied but not significant*

# Cysticercosis

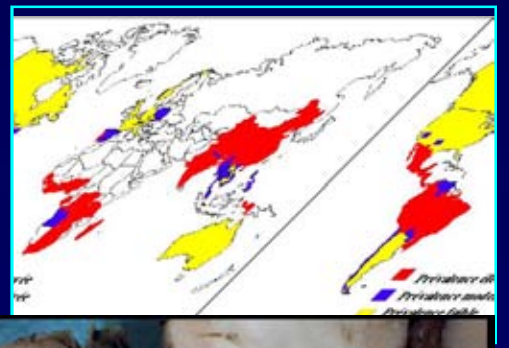
Infestation by the larval form of *Taenia solium*

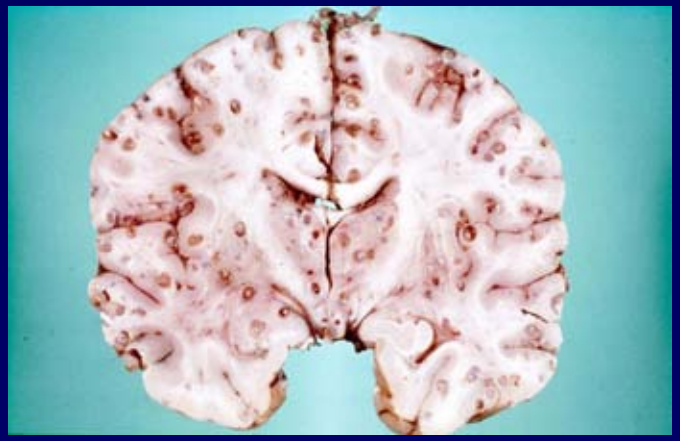
Pork = intermediate host

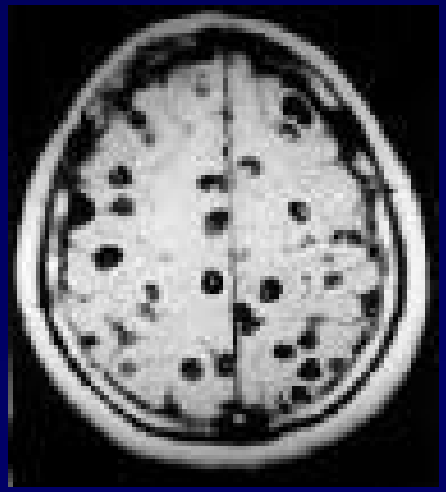
Encystation in the central nervous system

Very frequent acute seizures (~50%; up to 92%!)

First cause of late-onset epilepsy in endemic areas?



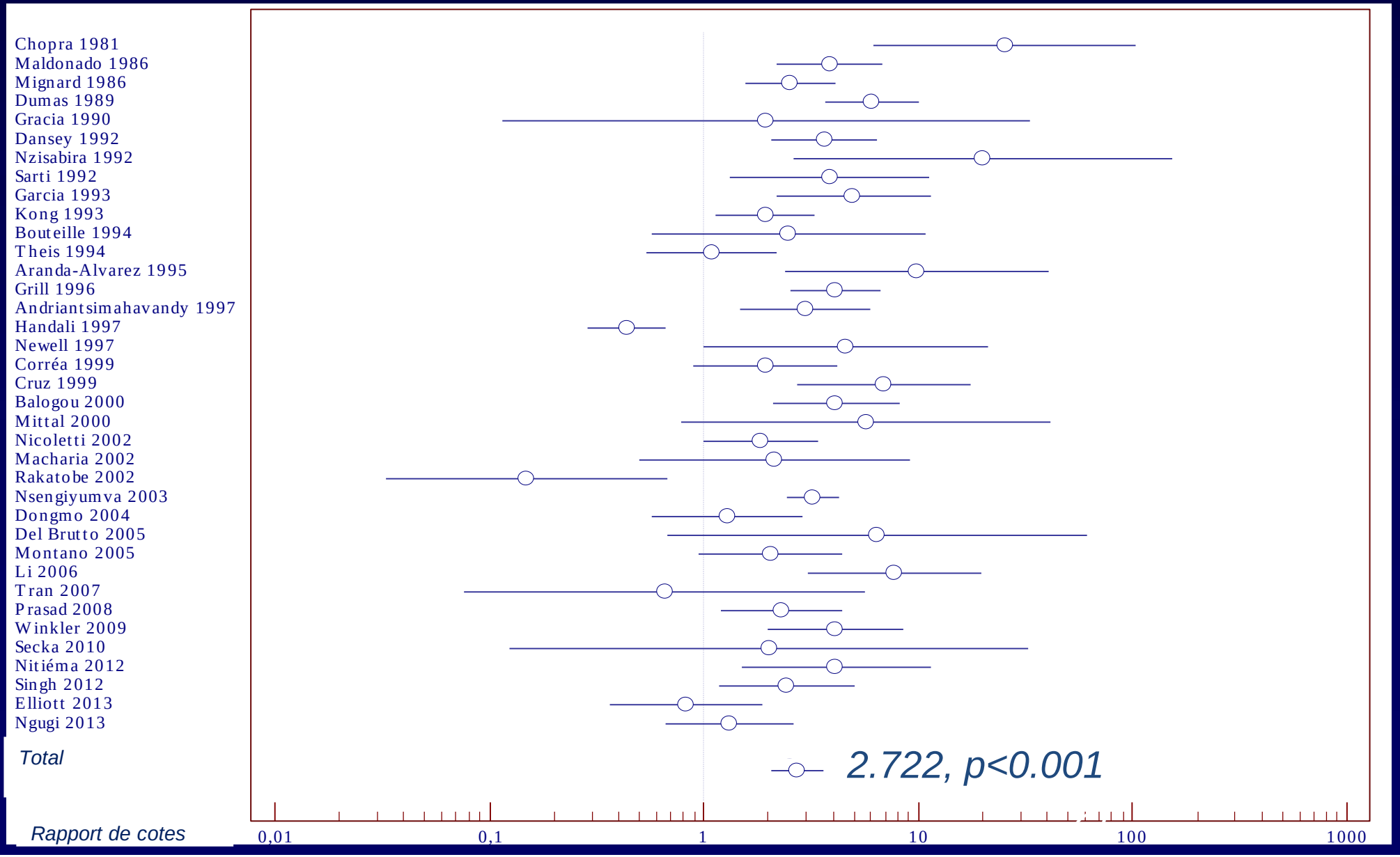




# Worldwide meta-analysis cysticercosis - epilepsy



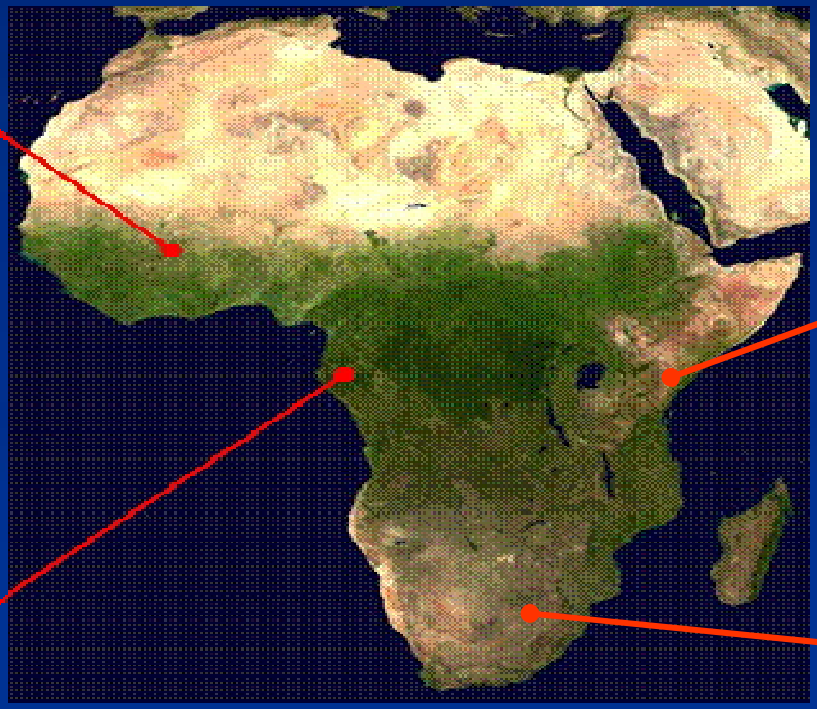
*Debacq et Preux, personal data*



# Cerebral malaria

## *Several recent epidemiological studies in sub-Saharan Africa*

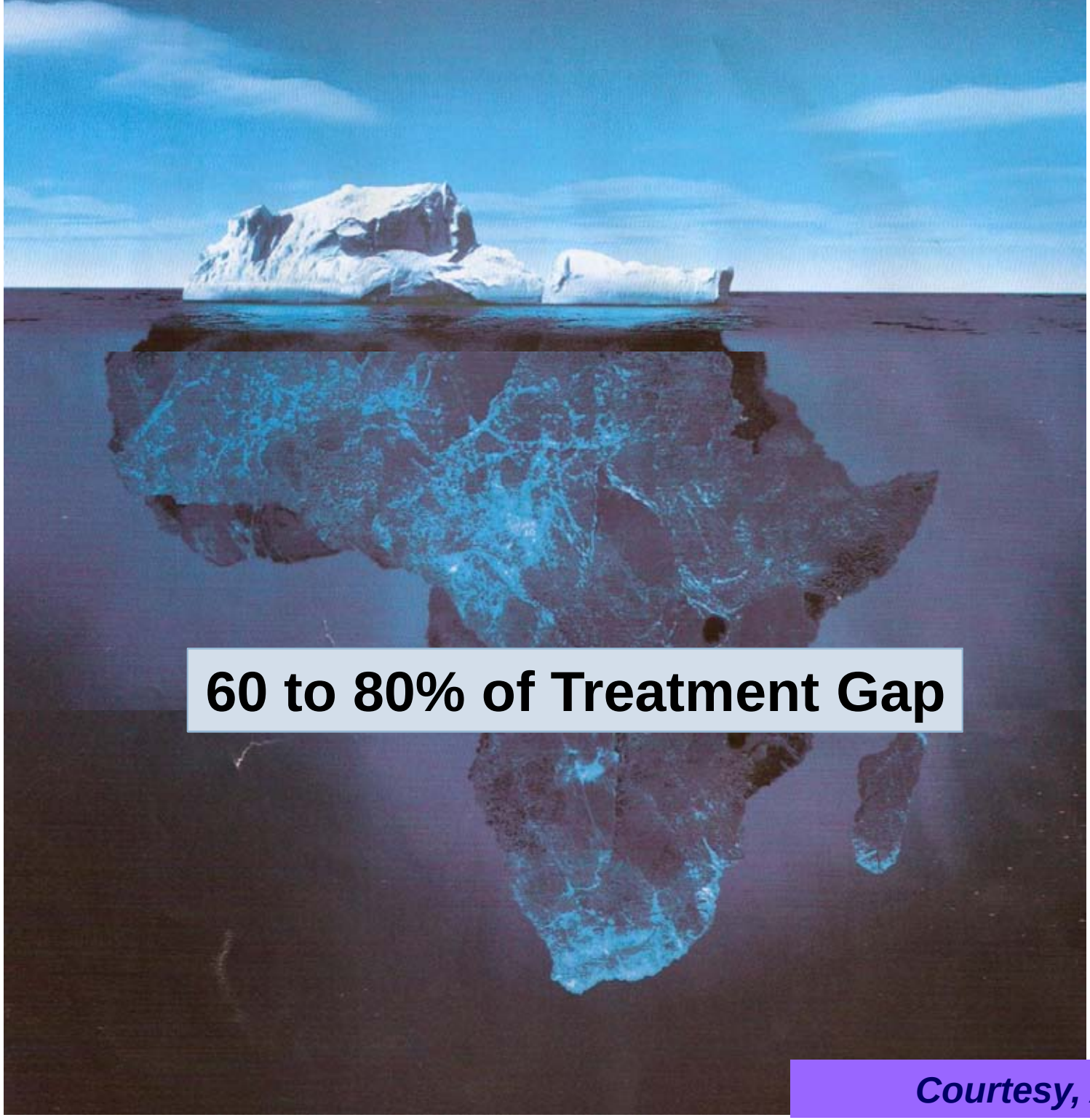

*Ngoungou et al.,*
*Epilepsia 2006; 47:2147-53.*




*Carter et al.,*
*Epilepsia 2004; 45: 978-81.*


*Ngoungou et al.,*
*Epilepsia 2006; 47: 873-9.*


*Birbeck et al.,*
*Lancet Neurol 2010; 9: 1173-81.*




*Courtesy, AG Diop*

# Causes of treatment gap

## Causes of a « diagnostic » treatment gap

Mistakes
No paraclinical examinations or trained staff
No access to health system (distance and/or cost)
Deny of the disease
Misbeliefs

## Causes of the treatment gap

No availability of the drug(s)
No money to buy the drug(s)
Low quality of the drug(s)
Prescription mistake
Choice to undergo only a traditional treatment

# Cultural context

? áSupernatural (punishment)

? áDevil action or ‘’bad eyes’’

? áUntreatable

? áContagious:

- saliva, blood, sweat, urines, breath
- breast feeding
- chicken feces
- contact with dogs…

***Courtesy, AG Diop***

# Very severe prognosis


- high frequency of seizures

(> 90% active epilepsies)

- injuries, drownings, burns into open fire
- status epilepticus
- undernutrition
- high mortality

# Prevalence and incidence of stroke in Africa

Prevalence studies

- South Africa: 300 / 100,000
- Tanzania: 200 / 100,000
- Nigeria: 114 / 100,000
- Nigeria: 58 / 100,000

Incidence-studies

- Nigeria: 15 / 100,000 / yr
- Zimbabwe: 30 / 100,000 / yr

*Connor et al., 2007; Adoukonou et al., 2010*

# Prevalence of stroke in Cotonou, Benin

| Age group years | Total population | | Males | | Females | |
|---|---|---|---|---|---|---|
| | stroke prevalence n/1,000 | number of strokes/ population size | stroke prevalence n/1,000 | number of strokes/ population size | stroke prevalence n/1,000 | number of strokes/ population size |
| 15–44 | 0.3 | 4/12,580 | 0.6 | 3/5,300 | 0.1 | 1/7,279 |
| 45–54 | 14.0 | 17/1,212 | 20.3 | 9/443 | 10.4 | 8/769 |
| 55–64 | 23.8 | 19/799 | 29.1 | 9/309 | 20.4 | 10/490 |
| 65–74 | 51.7 | 18/348 | 62.9 | 10/159 | 42.3 | 8/189 |
| 75–84 | 74.6 | 10/134 | 120.0 | 6/50 | 74.1 | 4/84 |
| 85+ | 66.7 | 2/30 | 111.1 | 1/9 | 47.6 | 1/21 |
| Total | 4.6 | 70/15,103* | 6.1 | 38/6,270 | 3.6 | 32/8,832 |

* Total population: 15,155; population size by age: 15,103, with 52 missing.

***Cossi et al., 2012***

# Incidence of ischemic cardiopathies and stroke in East Africa

| Model parameter | | Age groups in AfrE (years) | | | | |
|---|---|---|---|---|---|---|
| | | 30–44 | 45–59 | 60–69 | 70–79 | ≥80 |
| Disease incidence (per 1000 population) | | | | | | |
| Ischaemic heart disease | Men | 0.31 | 2.08 | 4.55 | 6.02 | 8.20 |
| | Women | 0.14 | 1.02 | 2.53 | 3.34 | 4.72 |
| Cerebrovascular disease | Men | 0.87 | 2.93 | 6.86 | 13.0 | 20.1 |
| | Women | 0.91 | 3.33 | 5.74 | 12.3 | 22.5 |

*Ortegon et al., 2012*

# Stroke mortality rates

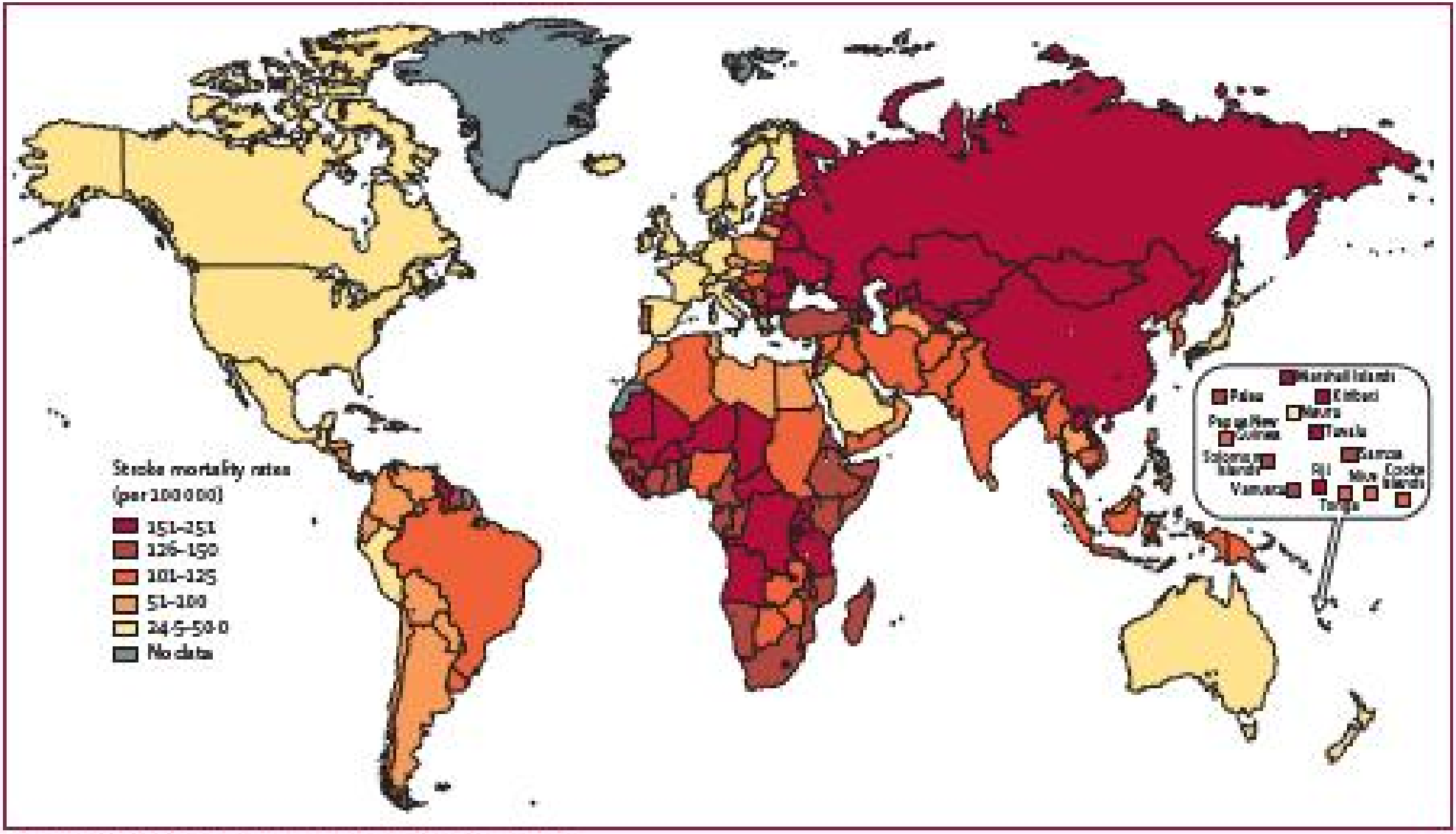



Figure 1: Age-adjusted and sex-adjusted stroke mortality rates
Rates are highest in eastern Europe, north Asia, central Africa, and the south Pacific.

*Johnston et al., 2009*

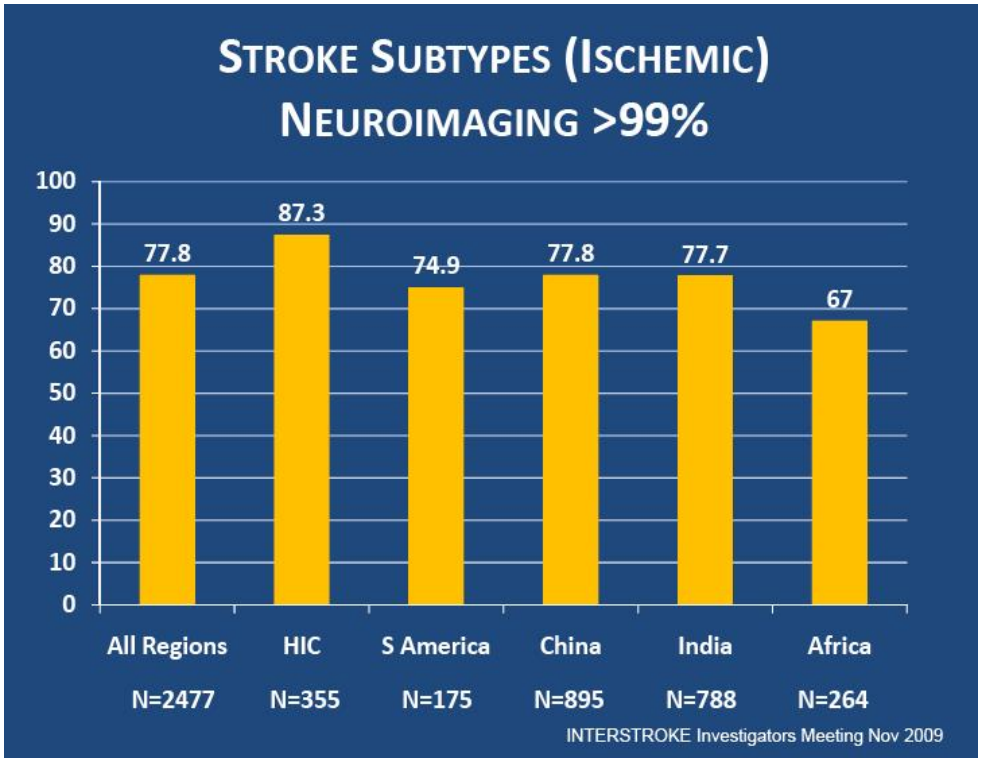
# Mortality from stroke, compared to myocardial infarction

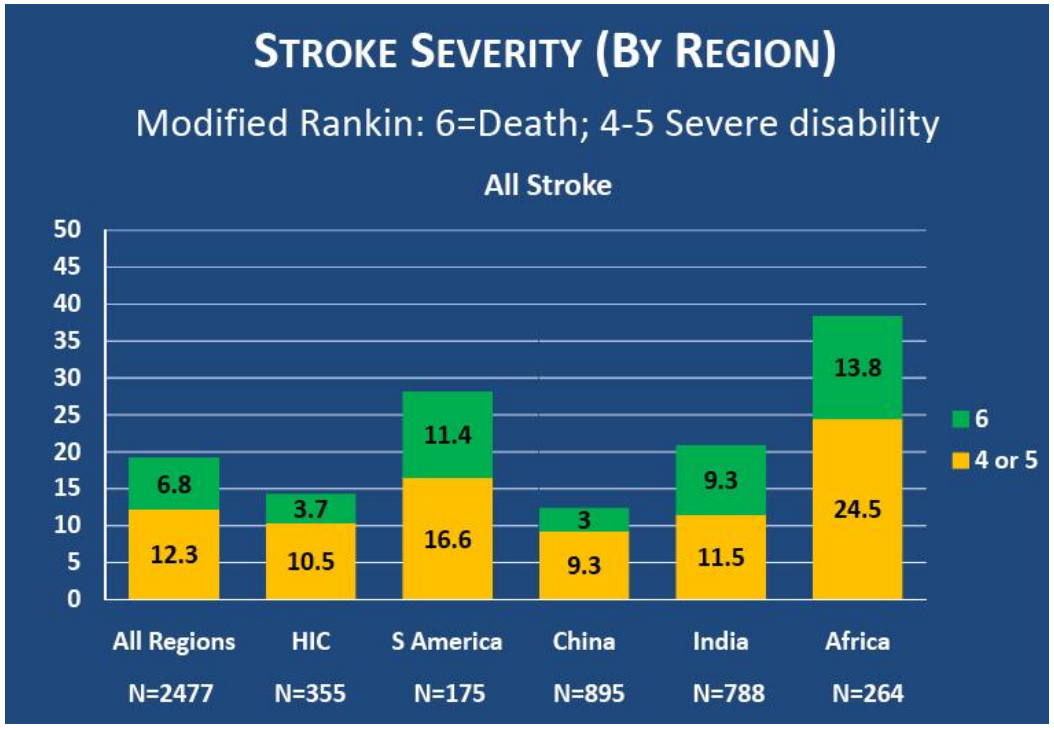
| Countries | Mortality / stroke per 100 000 / yr (% of global mortality) | Mortality / myocardial infarction per 100 000 / yr (% of global mortality) |
|---|---|---|
| Benin | 143 (8.8) | 113 (7.0) |
| Senegal | 143 (9.2) | 120 (7.7) |
| Congo | 123 (7.8) | 102 (6.5) |
| Gabon | 120 (8.5) | 103 (7.2) |
| France | 28 (6.1) | 38 (8.3) |

***Kim et al., 2011***

# INTER STROKE phase 1

- Africa
  - Mozambique, Nigeria, South Africa, Sudan, Uganda



Neurology®

# Stroke in Sub-Saharan Africa: An Urgent Call For Prevention

Jerome H. Chin

*Neurology* 2012;78;1007-1008
DOI 10.1212/WNL.0b013e318248df95

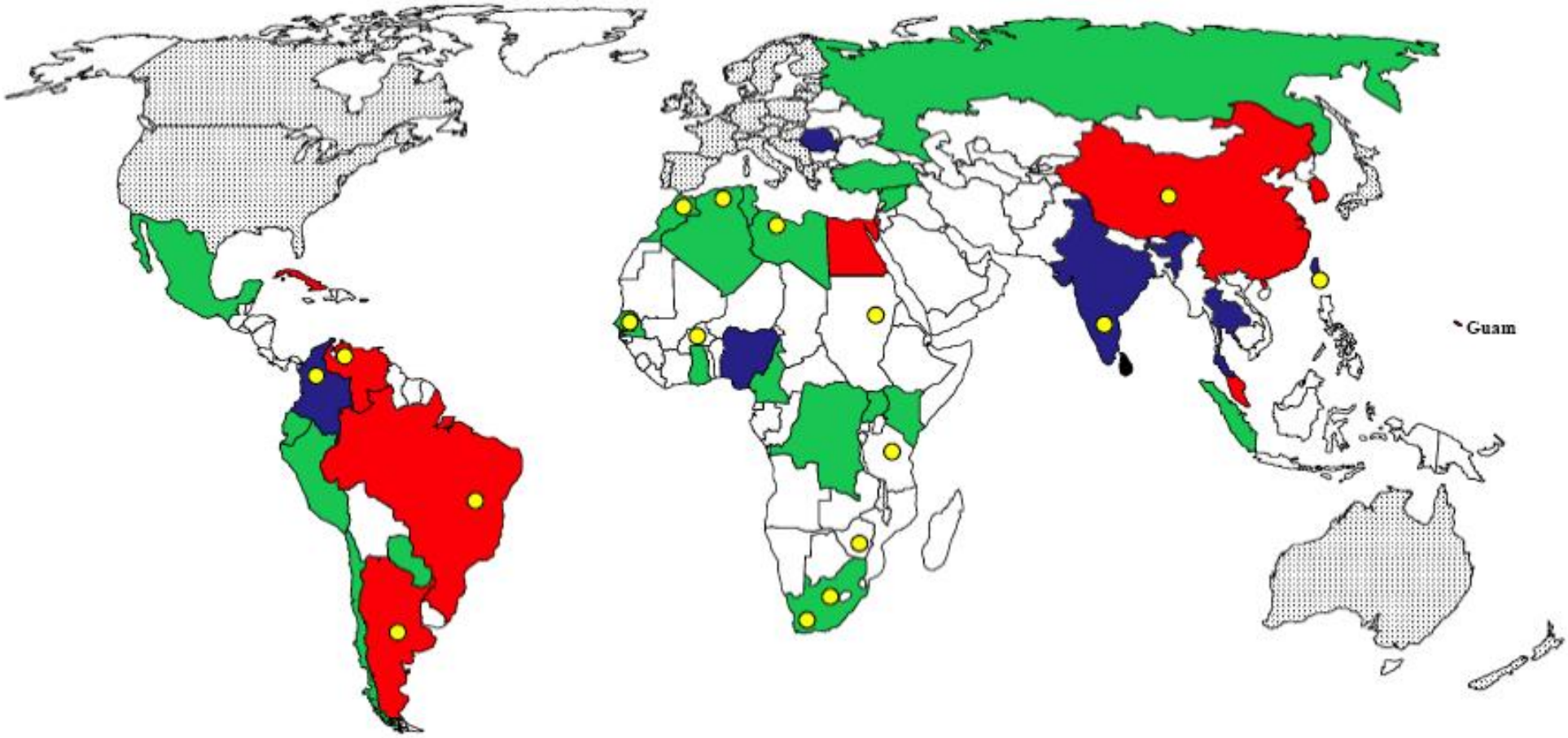
# NIGERIA : Ibadan / USA : Indianapolis Dementia Project

## *Ethnic group: Yorubas, + de 65 ans*

| **Prevalences** | *Dementia* | *AD* |
|---|---|---|
| **Ibadan, Nigeria** | 2.3% | 1.4% |
| **Indianapolis, USA** | 8.2% | 6.2% |

***Ogunniyi et al., 2000***

# Dementia




Prevalence or incidence comparable to developed countries

Associated factors studied but no prevalence data

Low prevalence <3%

Clinical cases reported

***10/66 Lancet Neurol, 2008***

# Africa

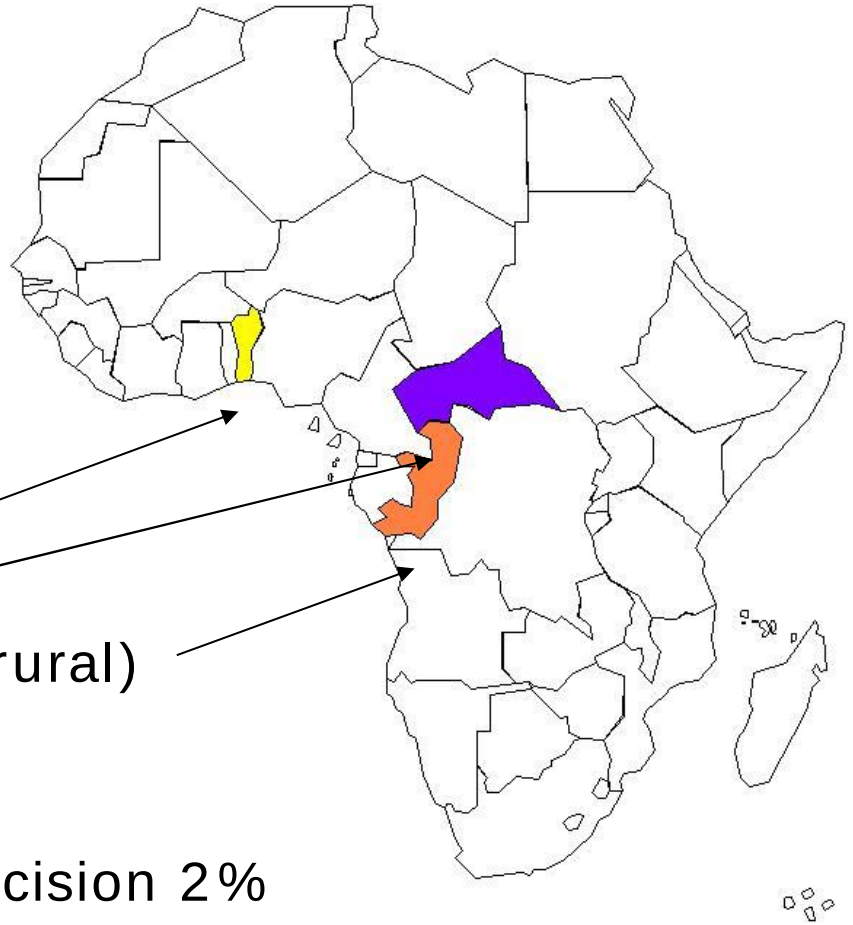
| Countries | | Prevalence of dementia (% & CI95%) |
|---|---|---|
| Mali | Bamako *(Traoré et al., 2002)* | AD = 1.2 |
| | Koulikouro *(Gunito et al., 2004)* | AD possible = 1.8<br>AD probable = 6.6 |
| Nigeria | Ibadan *(Hendrie et al., 1995)* | 2.3 (1.2-3.4) |
| | Jos *(Ochayi et al., 2006)* | 6.4 (3.8-9.9) |
| Tanzania *(Longdon et al., 2012)* | | ?á70 yrs: 6.4 (4.9-7.9) |

# Our studies in SSA (IENT, UMR1094 NET, Limoges)

## Benin, CAR, Congo

- Cross-sectional DTD
  population-based surveys
  ?z65 yrs

- Locations:
  - ü Benin: Cotonou (urban), Djidja (rural)
  - ü CAR: Bangui (urban), Nola (rural)
  - ü Congo: Brazzaville (urban), Gamboma (rural)



- Number of needed subjects:
  Based on expected prevalence 5%; precision 2%
  = 456 subjects ?-65 yrs
  è *500 subjects per site*

*Funded by*
*French Ministry of Foreign Affairs*
*French National agency for research,*
*AXA Research fund*

# Our results (IENT, UMR1094 NET, Limoges)

| Countries | | Crude prevalence of dementia (CI95%) | Crude prevalence of AD (CI95%) (%AD in dementia) |
|---|---|---|---|
| Benin | Djidja *(Guerchet et al., 2009)* | 2.6 (1.1-3.8) | 2.2 (1.1-3.9) (84.6%) |
| | Cotonou *(Paraïso et al., 2011)* | 3.7 (2.6-4.8) | 2.8 (1.9-3.9) (75.7%) |
| CAR | Bangui EDAC *(Guerchet et al., 2010)* | 8.1 (5.8-10.8) | 6.6 (4.6-9.2) (81.4%) |
| | Bangui ANR Epidemca* | 6.4 (4.4-8.9) | 4.4 (2.8-6.6) (68.7%) |
| | Nola ANR Epidemca* | 8.5 (6.1-11.3) | 7.8 (5.6-10.6) (91.7%) |
| Congo | Brazzaville EDAC *(Guerchet et al., 2010)* | 6.7 (4.7-9.2) | 4.6 (3.0-6.8) (68.6%) |
| | Brazzaville ANR Epidemca* | 6.6 (4.6-9.0) | 4.2 (2.6-6.3) (63.6%) |
| | Gamboma ANR Epidemca* | 5.7 (3.8-8.0) | 4.3 (2.8-6.4) (75.4%) |

** UMR1094, data 2013, not published*

# Mortality – Central Africa

- 93.4% of subjects followed-up (n=371/397)
- **Mortality after 2 yrs of follow-up:**

| | Dementia (n=75) | *p* | CIND (n=222) | *p* | Controls (n=105) |
|---|---|---|---|---|---|
| Bangui | 32.5% [CI95% : 18.6-49.1] | *p=0.016* | 12.1% [CI95% : 6.9-19.2] | *p=0.486* | 16.4% [CI95% : 8.1-28.1] |
| Brazzaville | 40.0% [CI95% : 23.9-57.9] | *p=0.009* | 13.3% [CI95% : 7.2-21.6] | *p=0.467* | 6.8% [CI95% : 1.4-18.6] |

*Dementia vs Controls: Bangui: p=0.059 / Brazzaville: p=0.004*

*No difference between towns*

Université de Limoges

***Guerchet, personal data***

# Genetic factors in dementia in SSA:

# ApoE, no link??

**Benin** *(Guerchet et al., 2009)*

- ü No influence of ApoE epsilon 4
- ü ApoE epsilon 2: OR=0.12 (CI95%=[0.02-0.89]), p=0.038

**Kenya** *(Chen et al., 2010)*

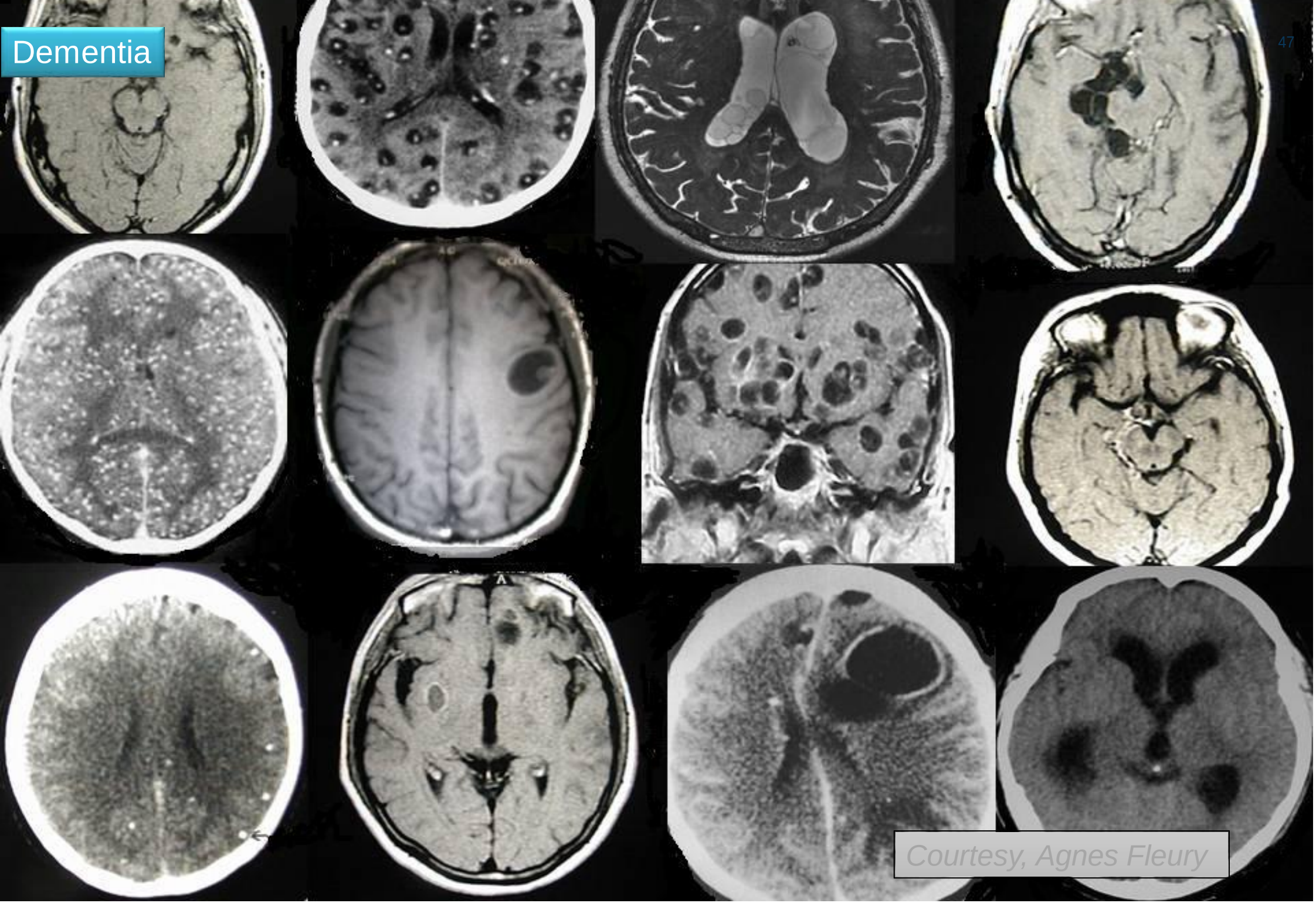
**Nigeria** *(Gureje et al., 2006 ; Hall et al., 2006)*

**Tanzania** *(Sayi et al., 1997)*

- ü No influence of ApoE epsilon 4

# Dementia





Courtesy, Agnes Fleury

# Parkinson Disease

Only few community – based studies *(Ethiopia, Nigeria, Tanzania, Togo)*:

*Movement Disorders*
Vol. 21, No. 12, 2006, pp. 2150–2156


## Parkinson's Disease in Africa: A Systematic Review of Epidemiologic and Genetic Studies

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**TABLE 2.** *Prevalence studies of Parkinsonism and Parkinson's disease in Africa*

| Country[a] | Year (study duration) | Population size | Crude prevalence[b] (per 100,000) | Prevalence in specified age range[b] | Diagnostic criteria or protocol |
|---|---|---|---|---|---|
| Nigeria[27,28] | 1982 (1.5 yr) | 20,000 | 10 | 59 (> 39 yr) | WHO protocol and three of four cardinal signs |
| Libya[29] | 1982 (~ 2 yr) | 518,745 | 31.4 | 285.1 (> 50 yr) | Two of 4 cardinal signs; no exclusion criteria |
| Tunisia[30] | 1985 (~1 month)[d] | 34,874 | 43 | 216 (≥ 40 yr)<br>296 (≥ 50 yr) | WHO protocol[c] |
| Ethiopia[31] | 1986 (~2 yr) | 60,820 | 7 | | Not detailed |
| Togo[32] | 1989 | 19,241 | 20 | — | WHO protocol[c] |
| | 1995 | 4,182 | 20 | — | WHO protocol[c] |

# Parkinson Disease

The Prevalence of Parkinson's Disease in Rural Tanzania

Catherine Dotchin,[1*] Olivia Msuya,[2] John Kissima,[3] John Massawe,[3] Ali Mhina,[3] Addess Moshi,[3] Eric Aris,[4] Ahmed Jusabani,[5] David Whiting,[6] Gabriel Masuki,[3] and Richard Walker[1]

n = 161,071

Prevalence: 20/100 000

Prevalence std: 40/100 000

**Parkinsonism in a population of northern Tanzania: a community-based door-to-door study in combination with a prospective hospital-based evaluation**

**Andrea Sylvia Winkler · Esra Tütüncü · Anna Trendafilova · Michael Meindl · John Kaaya · Erich Schmutzhard · Jan Kassubek**

n=1569 ? 50 yrs

Prevalence: 0??

'We call it the shaking illness': perceptions and experiences of Parkinson's disease in rural northern Tanzania

Gerry Mshana[1*], Catherine L Dotchin[2] and Richard W Walker[3]

***Dotchin et al., 2008; Winkler et al., 2010; Mshana et al., 2011***

# Migraine

## Some prevalence studies in Africa

Table 4 Some migraine prevalence studies among populations

| Year | Authors (references) | Country | Migraine definition | Timeline | Population | Age of interviewees, years | Prevalence | | Overall prevalence, % |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | M | F | |
| 1982 | Osuntokun et al. (10) | Nigeria | AHC | – | Rural community | All | 4.6 | 8.8 | 6.7 |
| 1983 | Levy (23) | Zimbabwe | AHC | 1 year | Rural community | >5 | 3.5 | 8.9 | 4.2 |
| 1984 | Ogunyemi (18) | Nigeria | AHC | Whole life | Students | 16–42 | 15.6 | 19.8 | 16.7 |
| 1988 | Longe and Osuntokun (24) | Nigeria | – | – | Rural community | All | | | 6.3 |
| 1992 | Osuntokun et al. (11) | Nigeria | AHC | – | Urban community | All | 5.0 | 5.6 | 5.3 |
| 1993 | Romdhane Attia et al. (25) | Tunisia | – | – | – | 0–100 | 2.5 | 4.5 | 3.4 |
| 1995 | Matuja et al. (26) | Tanzania | AHC | 2 years | Urban community | 20–40 | – | | 7.2 |
| 1995 | Tekle-Haimanot et al. (9) | Ethiopia | IHS | 1 year | Rural community | >20 | 1.7 | 4.2 | 3.0 |
| 2004 | Dent et al. (8) | Tanzania | IHS | 1 year | Rural community | >11 | 2.5 | 7.0 | 5.0 |
| 2003 | Our Study | Benin | IHS | Lifetime | Rural community | >15 | 2.2 | 4.0 | 3.3 |

Perfect illustration of wide methodological variations in data collection, criteria, timelines, populations…

# Example of a rare disease: ALS

## v Literature review

ø **35 studies - ALS in Africans**

- 21 performed in Africa
- 14 migration studies

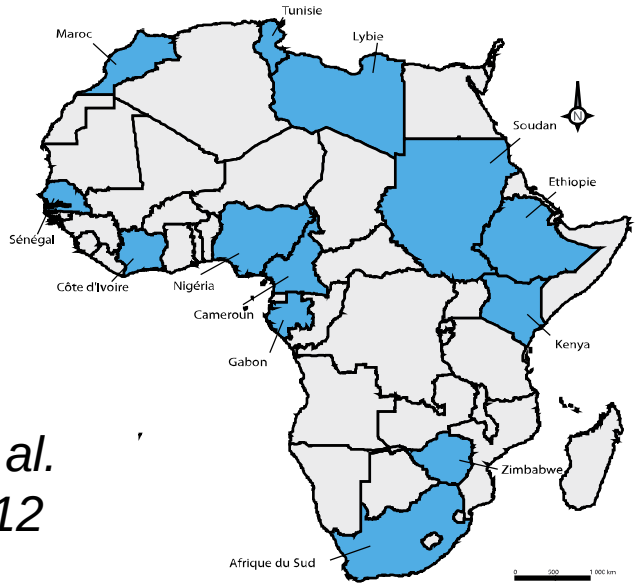
ø **Characteristics of ALS**

- Younger age at onset: 50 years
- Existence of juvenile forms
- Median SR: 2.75

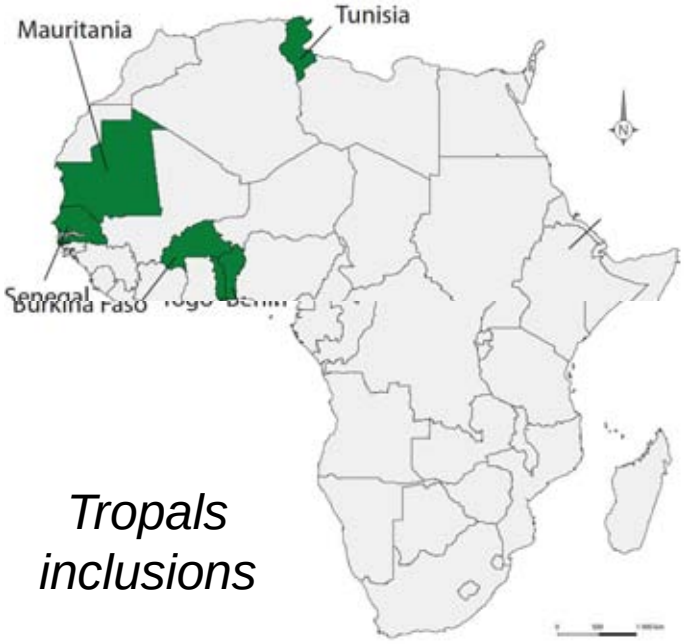
***Problems of the availability of data for population-based estimates***

## v TROPALS study (n=44)

- Mean age: 52 years
- 1 case<25y; 2 cases<30y
- SR: 2.60




*Marin et al. ALS, 2012*




*Tropals inclusions*

- ü Africa: a huge continent
- ü Methodological challenges
- ü Global burden of diseases
- ü Focus on some diseases
- ü Conclusion

# Conclusions

- Methodological challenges
- Too few well-conducted studies
- Realities vary regions to regions, or countries to countries, and sometimes even within the same countries, depending for example of the risk factors
- Progression of neurological and mental health disorders in terms of DALY and deaths

**Neuroepidemiological studies in Africa are now not only a necessity**

# but an emergency…

***What can be done ?***

1. Improve and stimulate training by research
2. Propose methodological support
3. Approach global funding and skateholders
4. Increase number of studies

# 1. Improve and stimulate training by research

***Master + PhD***

**MASTER**

Neuroépidémiologie et Parasitologie Tropicales

As an example : **Master Degree in Tropical Neuroepidemiology and Parasitology, Limoges, France**

- **PhD in cotutorship +++**
- **Intensive courses in Africa in Neuroepidemiology (initiatives exist)**
- **International organizations could play a role**

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# 2. Propose methodological support

## *Create or develop methodological Units*

- **Sub-regional or regional first**
- **In each country in a second time**

**True technical plate-forms**

**with skills in creating databases, data-management, biostatistics with professional softwares**

**HUMAN RESOURCES**


**= one of the keys towards publications in higher level journals**

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# 3. Approach global funding and skateholders

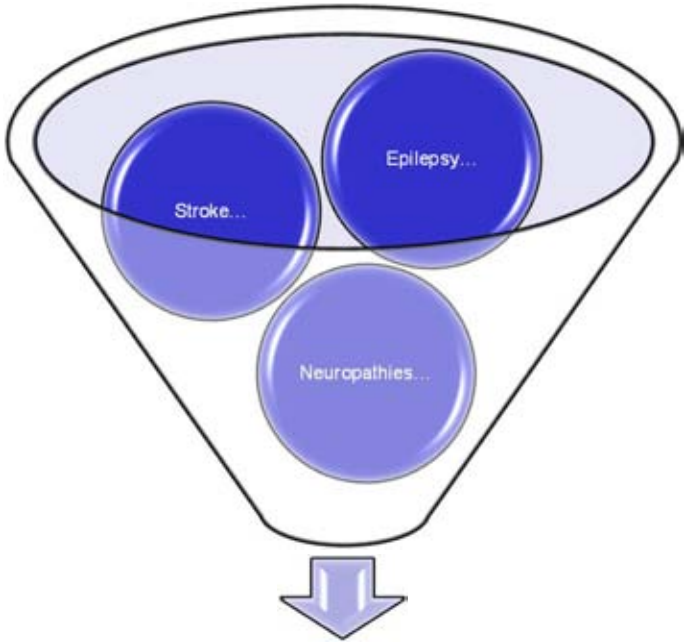
***As usual, money is the point…***

**WFN could help in this matter**

- **Scholarships**
- **Funds to start the process of methodological units**
- **Seed money for starting research**
- **And then possibility to propose well developed ambitious protocols**
  - **Interregional**
  - **Comparative epidemiology**
  - **To raise and test new hypotheses**

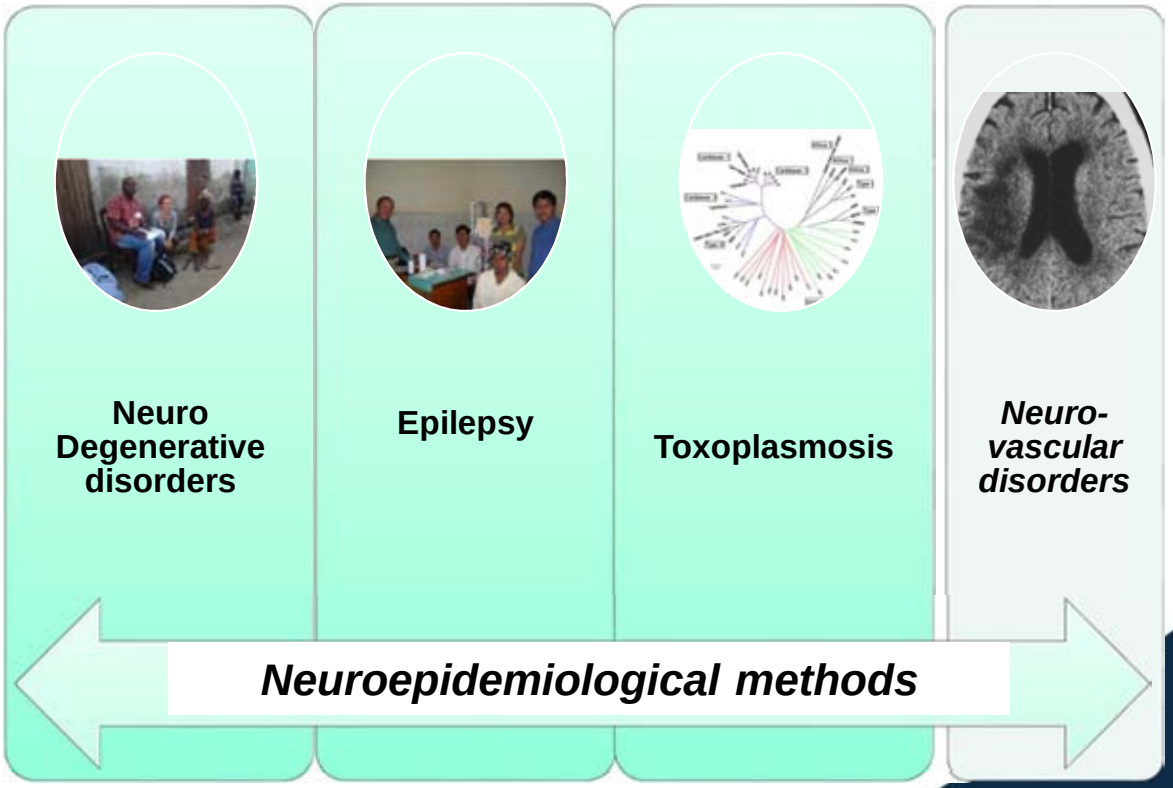
# 4. And then make many more studies…

***Everybody could be involved!***




***Researches***

**Inserm U1094 Research axes 2012-2017**

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# Concepts and methods in neuroepidemiology research are worldwide the same

## Neuroepidemiological research is feasible in Africa and needs development


Thank you for your kind attention

# Complementary slides

**Box 2: Global Burden of Disease methodology**

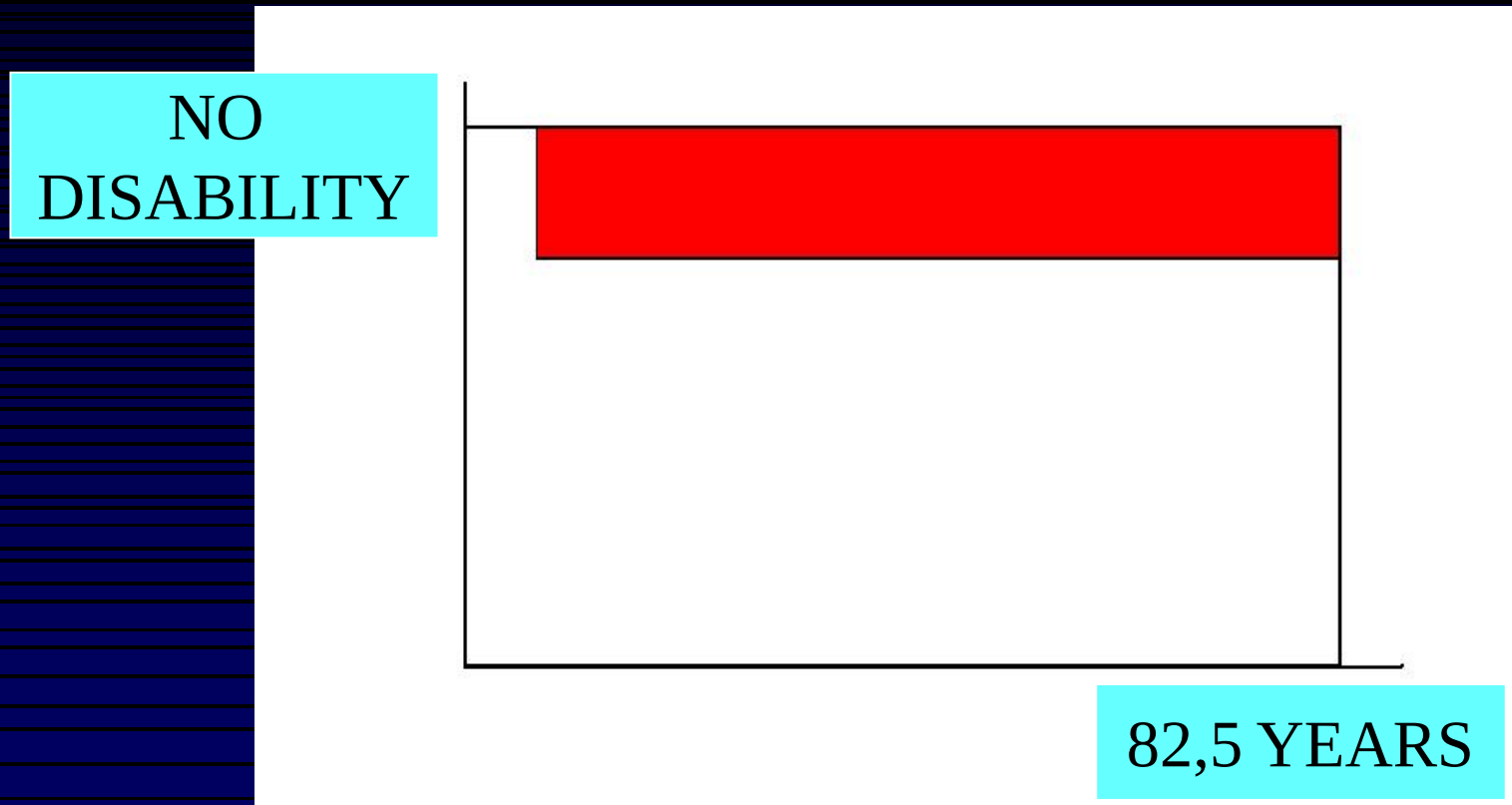
GBD uses thousands of data sources from around the world to estimate disease burden. As a first step, GBD researchers estimate child and adult mortality using data sources such as vital and sample registration systems, censuses, and household surveys. Years lost due to premature death from different causes are calculated using data from vital registration with medical certification of causes of death when available, and sources such as verbal autopsies in countries where medical certification of causes of death is lacking. Years lived with disability are estimated using sources such as cancer registries, data from outpatient and inpatient facilities, and direct measurements of hearing, vision, and lung function testing. Once they have estimated years lost due to premature death and years lived with disability, GBD researchers sum the two estimates to obtain disability-adjusted life years. Finally, researchers quantify the amount of premature death and disability attributable to different risk factors using data on exposure to, and the effects of, the different risk factors. For more information about the GBD methods, see the Annex of this report as well as the published papers.

# Disability Adjusted Life Years (DALY)

- The only differences in the rating of a death or disability should be due to age and sex, not to income, culture, location, social class. A common measurement unit for morbidity and mortality.
- Everyone in the world has right to best life expectancy in world.
- Facilitates comparisons of all types of health outcomes.
- DALY = YLL + YLD
  - Years of Lost Life (due to mortality)
  - Years Lost to Disability (due to injury & illness)

# DALYs due to living with disability

## (Red area measures DALYs. Red + white is a “normal” life)



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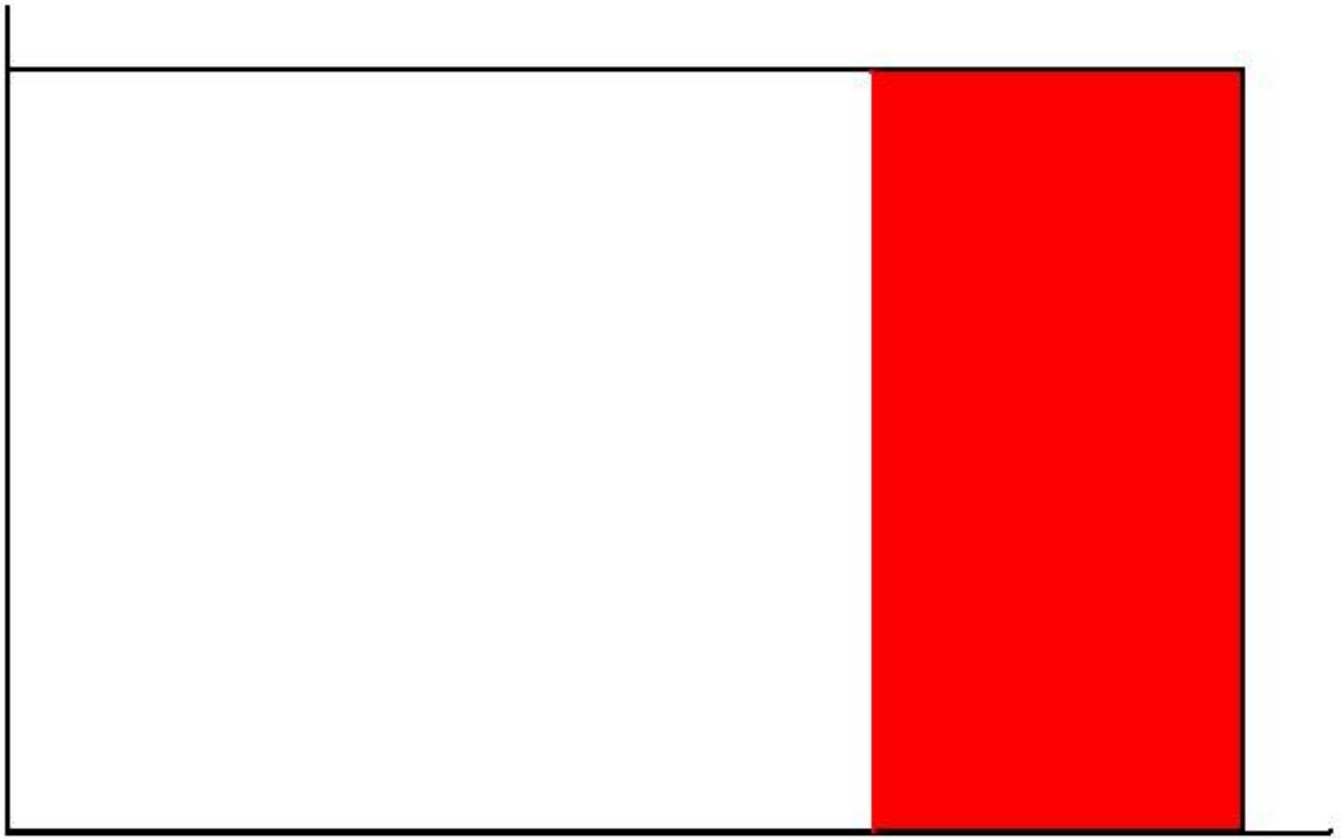
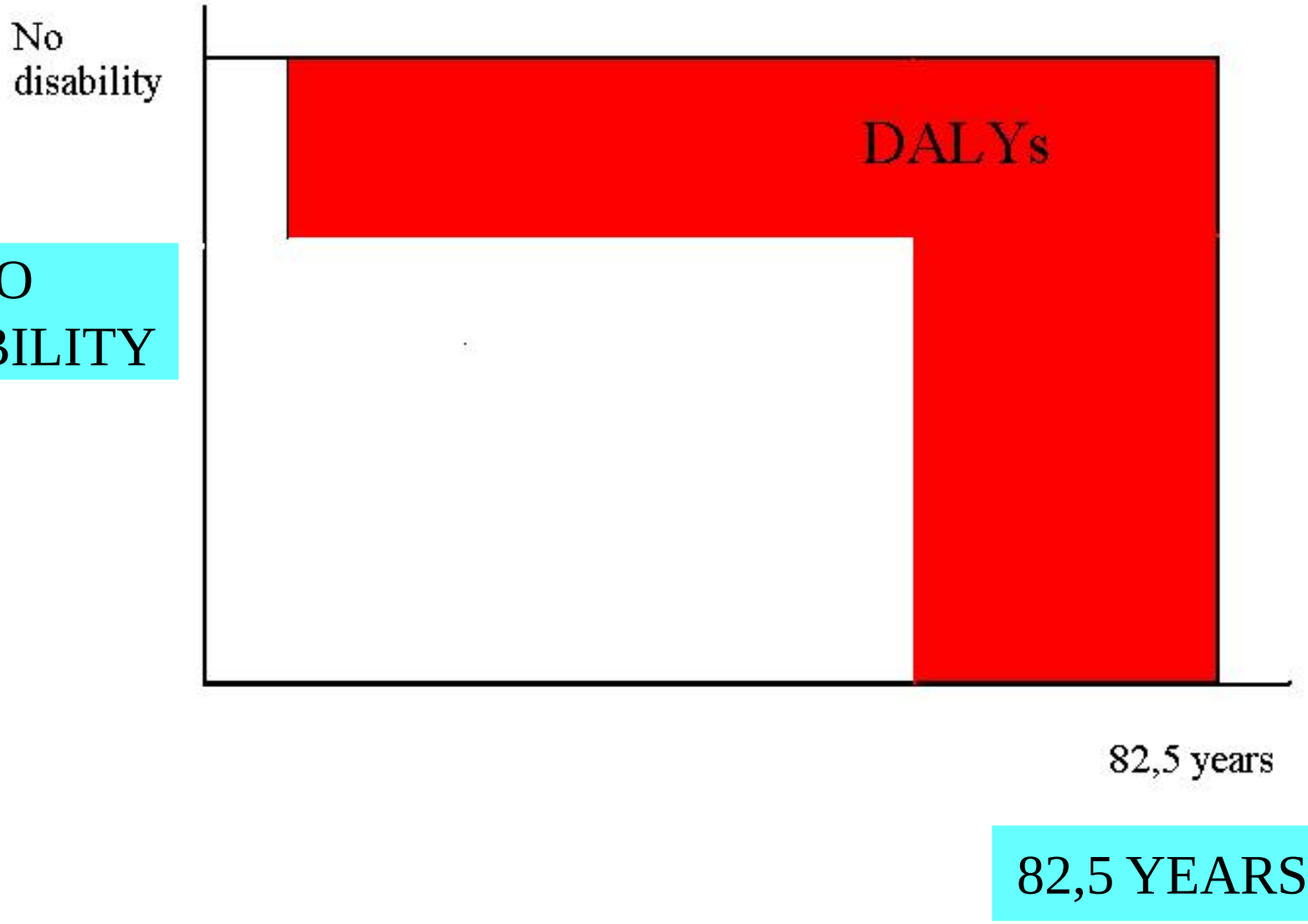
NO DISABILITY



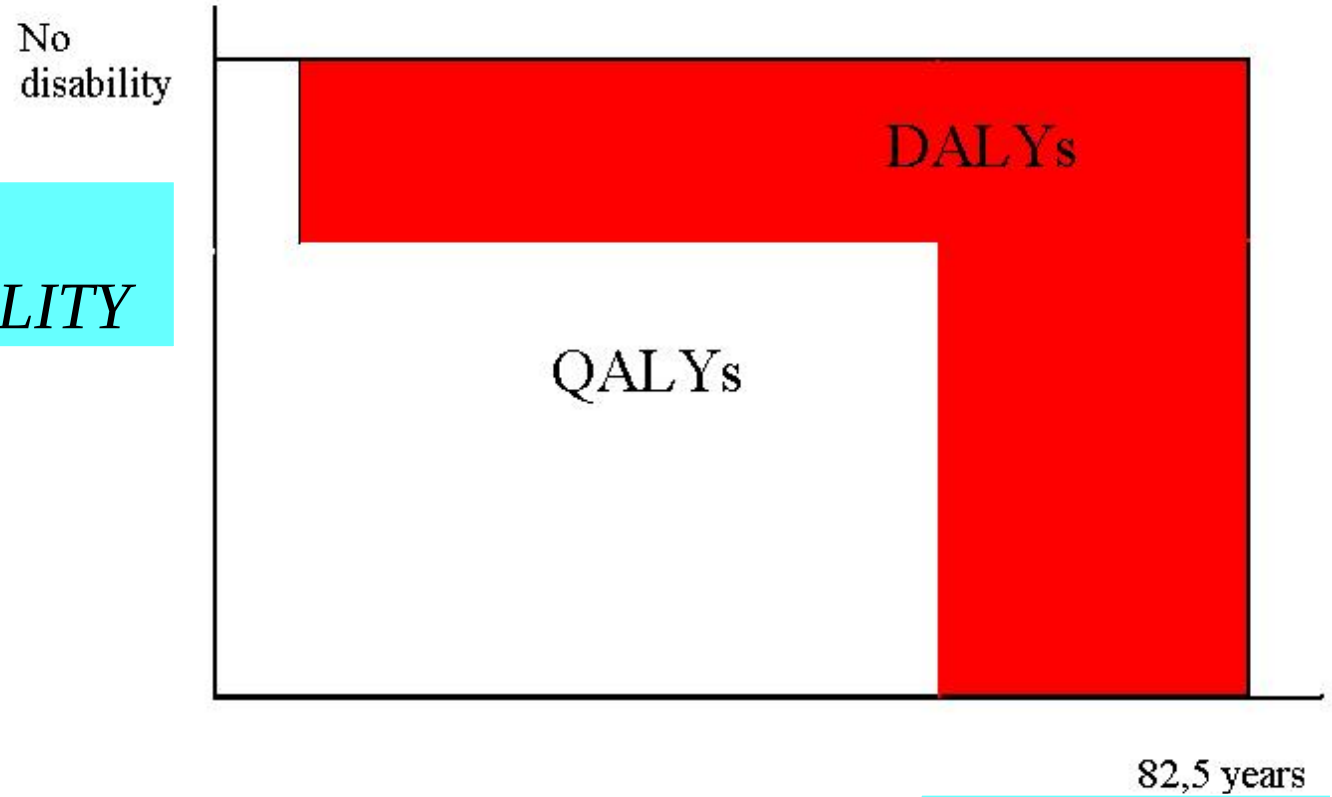

82,5 YEARS




NO DISABILITY

82,5 YEARS

# Relation between QALYs and DALYs




*NO DISABILITY*

*82,5 YEARS*

# DALY, GBD, 2010

- *Progress on some communicable diseases but they stay on the top*

- *All of the neurological or mental health disorders increased between 1990 and 2010 (stroke, epilepsy, depression)*