



# Fragility fractures in Sub-Saharan Africa: The known unknowns!

Dr Celia L Gregson

Consultant Senior Lecturer, Musculoskeletal Research Unit

University of Bristol

&

Honorary Consultant Orthogeriatrician

Royal United Hospital Bath

# Disclosures

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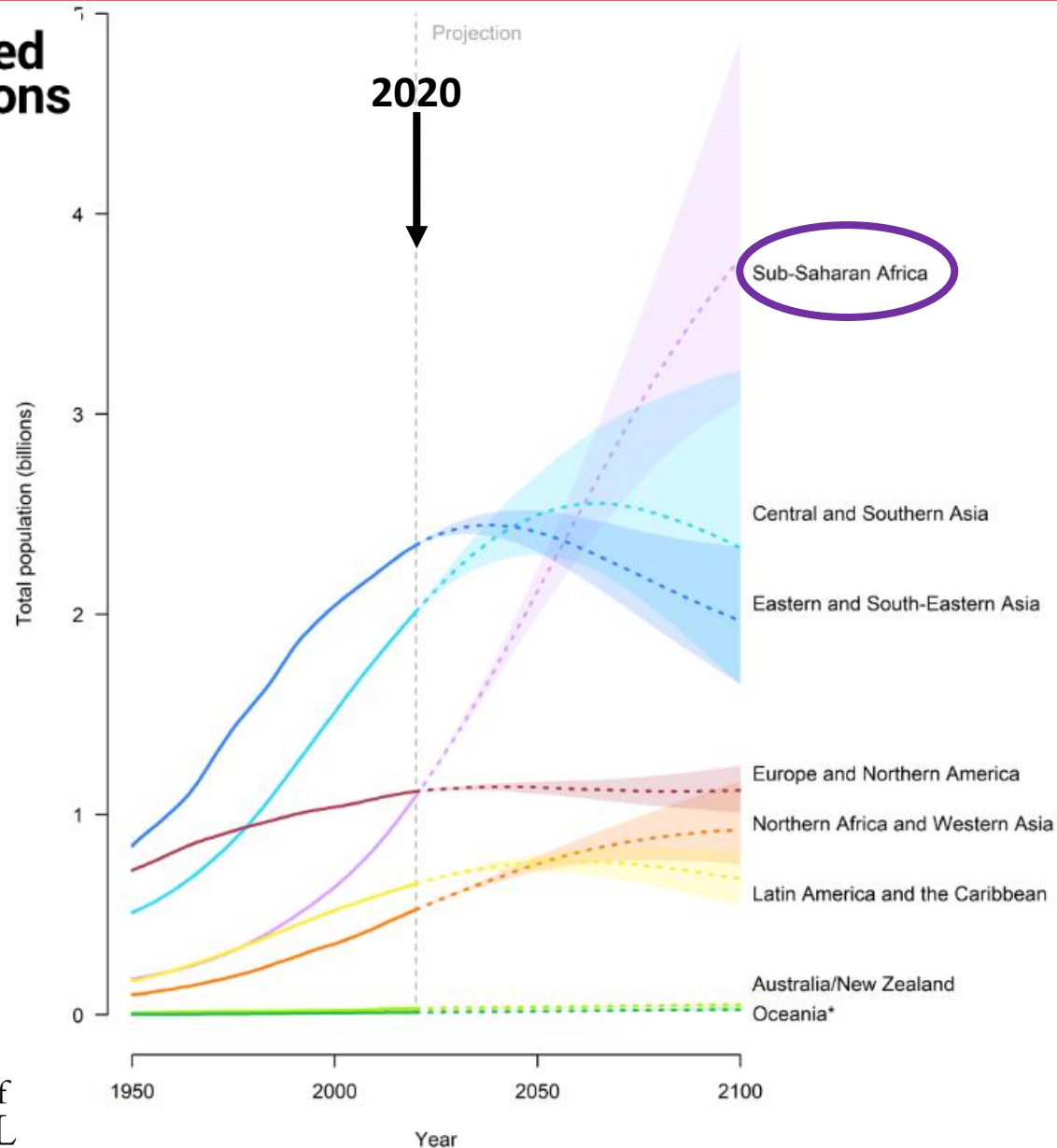
Chair of the Royal College of Physicians (RCP) Falls and Fragility Fracture Audit programme (FFFAP) Scientific and Publications committee

Chair of the National Osteoporosis Guideline Group (NOGG), UK

# Population growth by region, 1950-2020, and projections to 2100

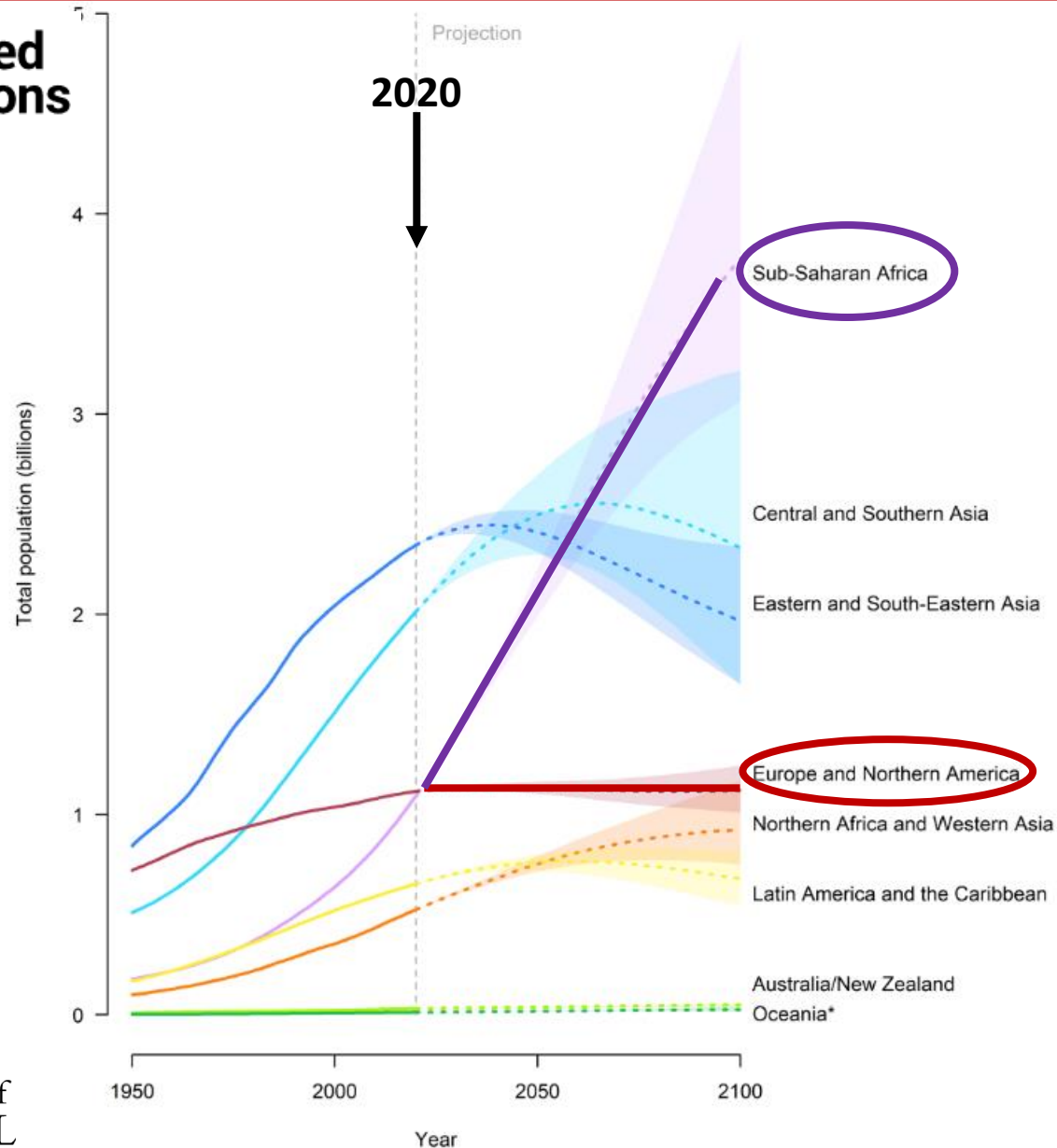


United Nations



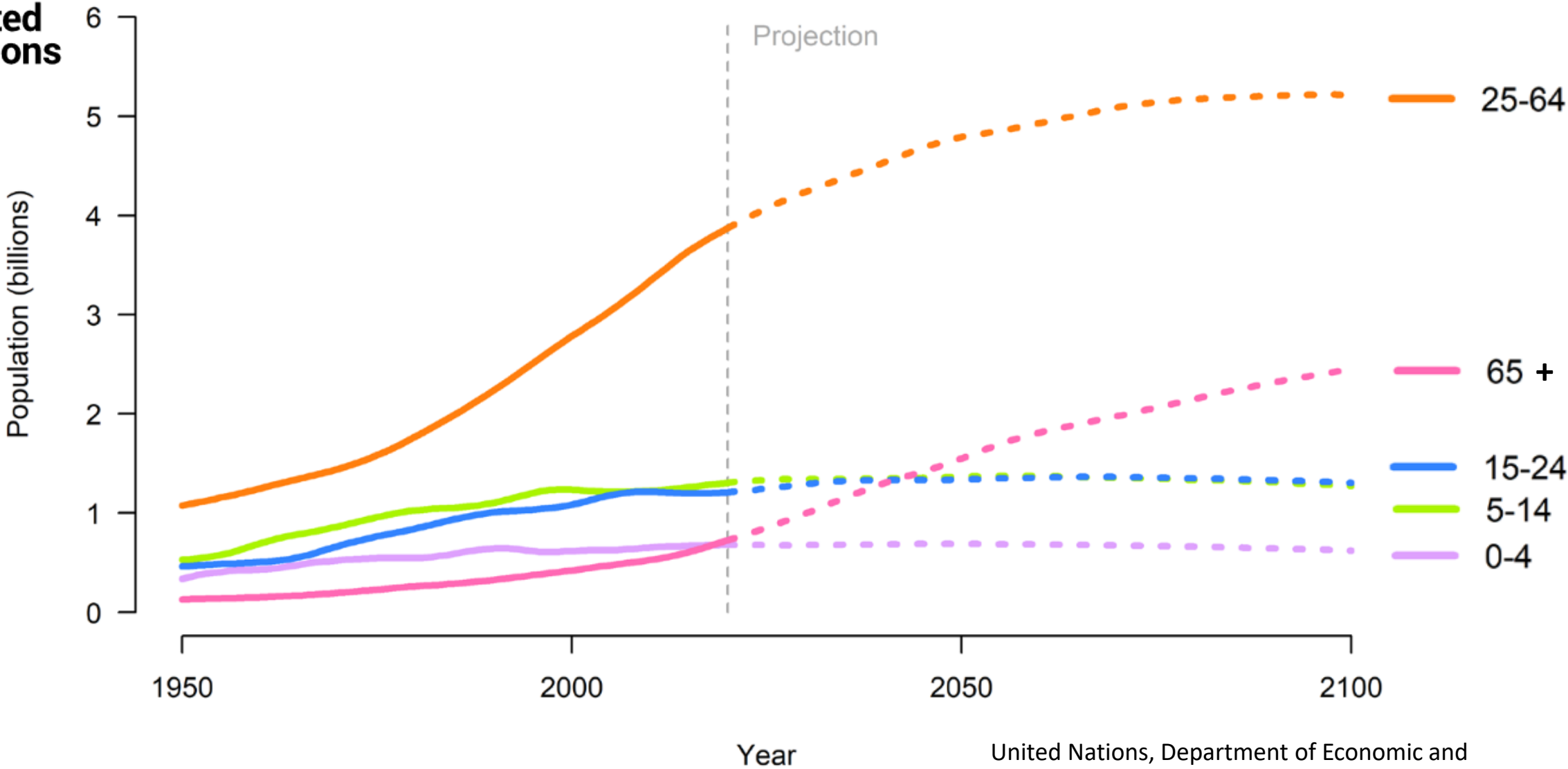
Of the eight regions, only sub-Saharan Africa is projected to sustain rapid population growth through to the end of the century

# Population growth by region, 1950-2020, and projections to 2100



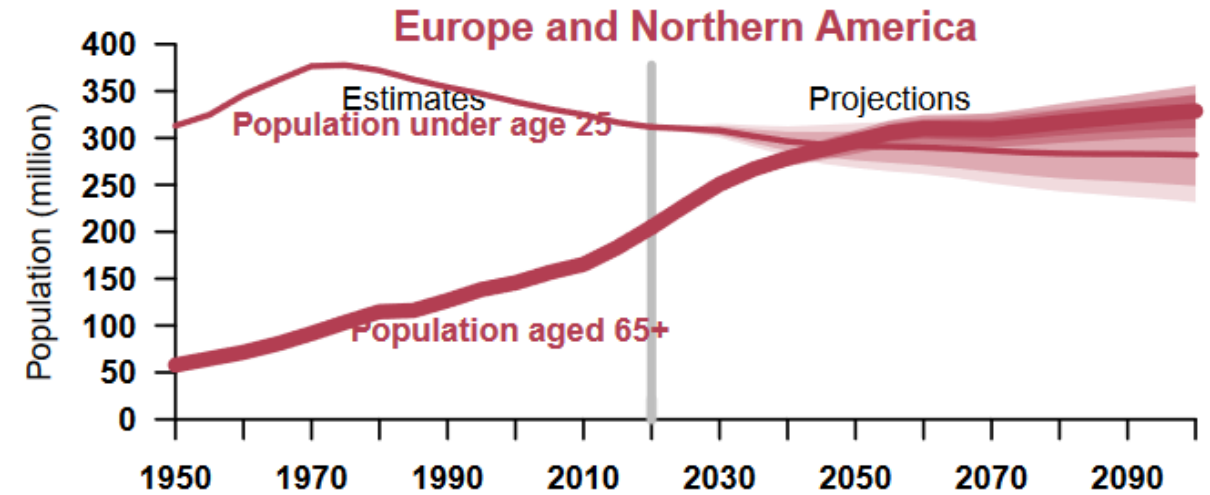
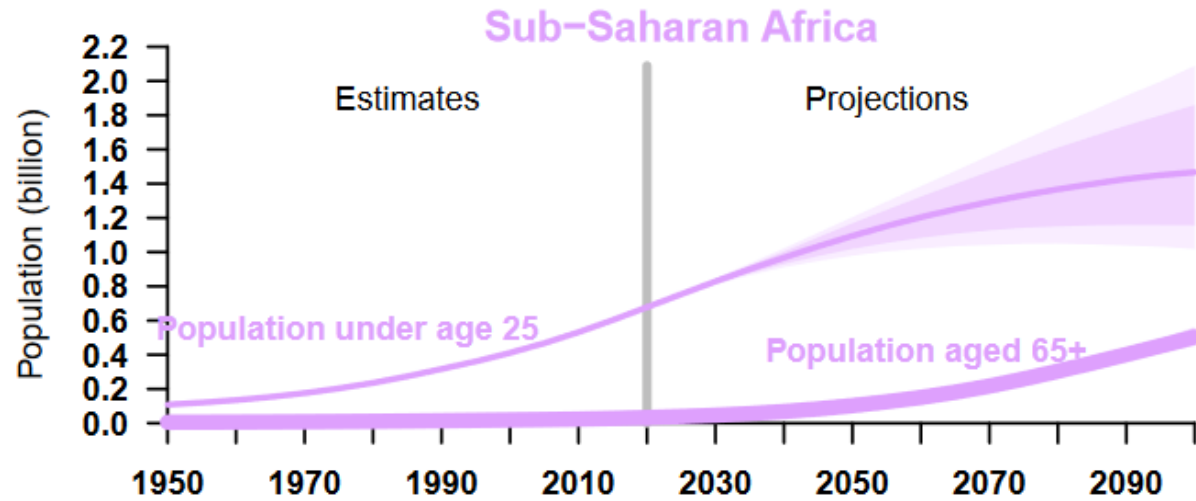
Of the eight regions, only sub-Saharan Africa is projected to sustain rapid population growth through to the end of the century

# Globally, those aged 65+ years make up the fastest-growing age group

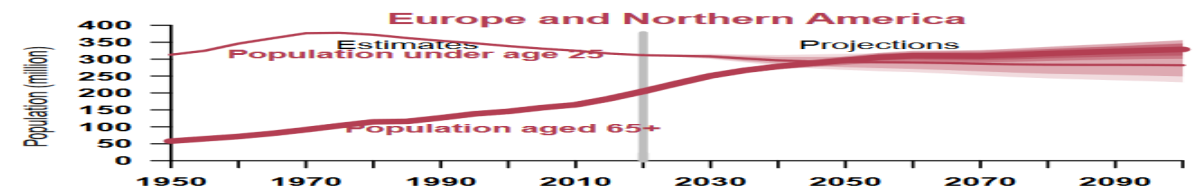
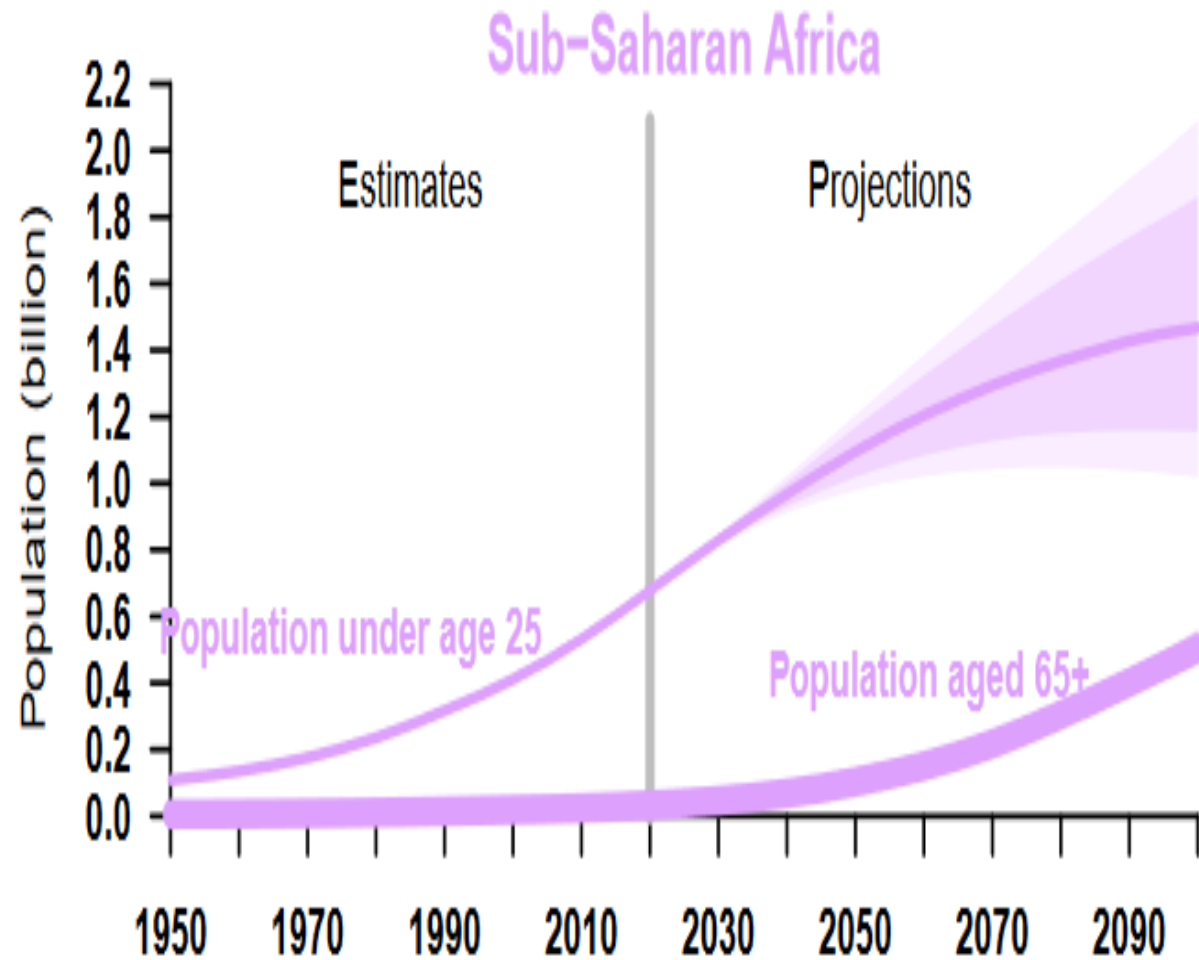


United Nations, Department of Economic and Social Affairs, Population Division  
World Population Prospects 2019

# By 2100, 13% of all people aged 65+ will be living in sub-Saharan Africa



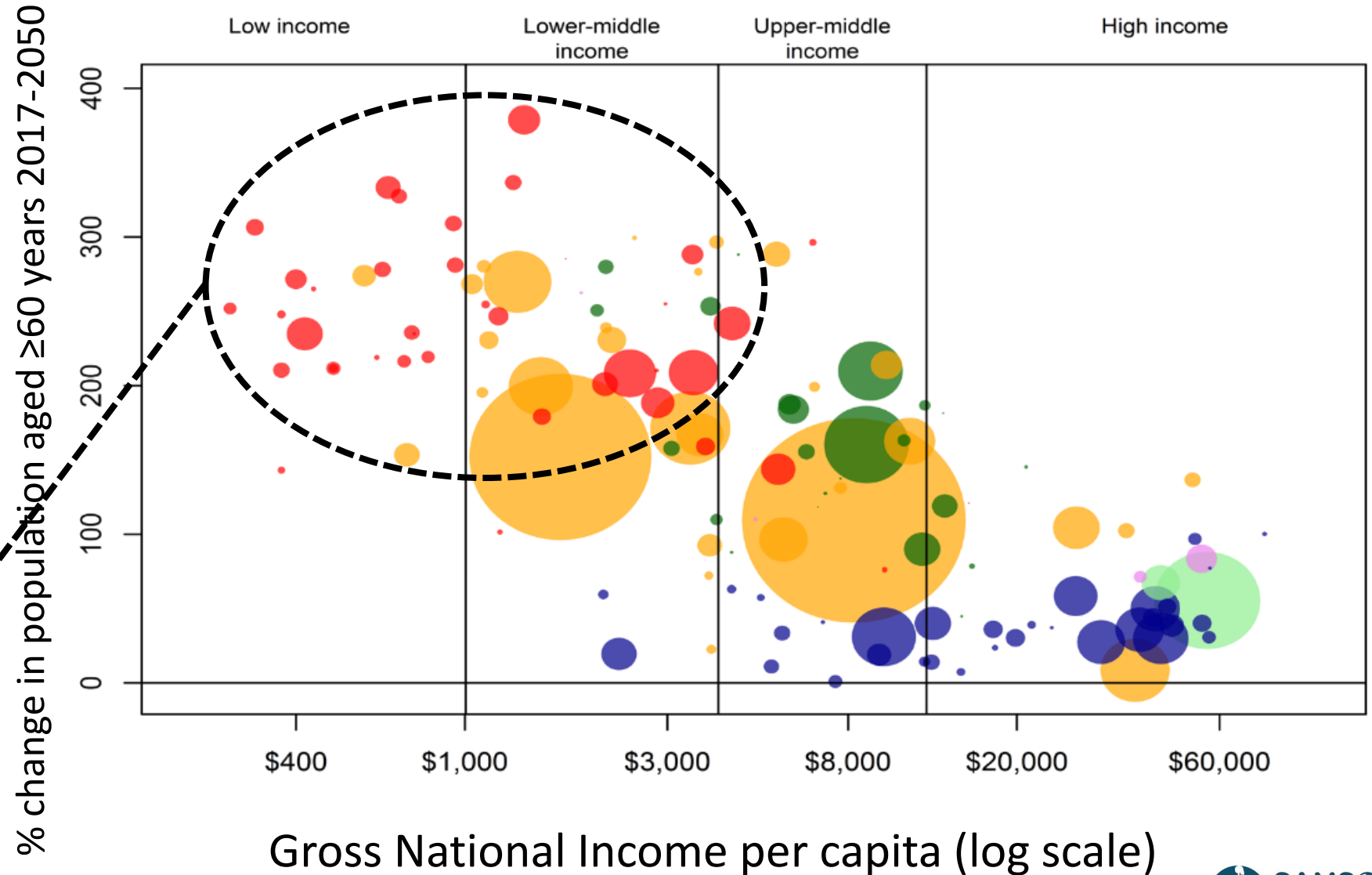
By 2100, 13% of all people aged 65+ will be living in sub-Saharan Africa



# The UN and World Bank projections for Population Ageing vs. National Income (2017-2050)

- Africa
- Asia
- Oceania
- Latin America
- Europe
- Northern America

**The greatest age growth, disproportionate to income, will be seen in Africa over the next 30 years**





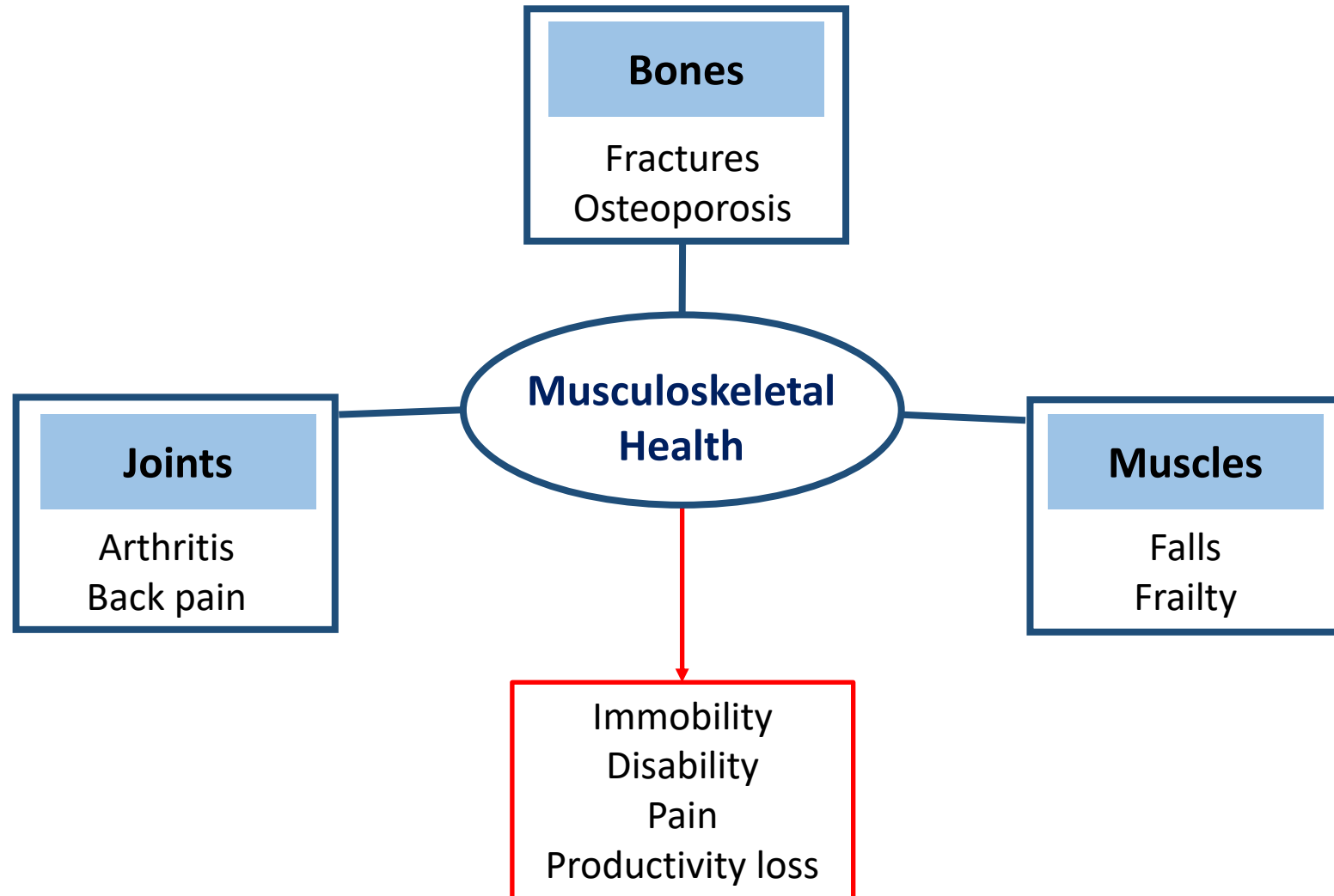
# 2020-2030: WHO Decade of Health Ageing

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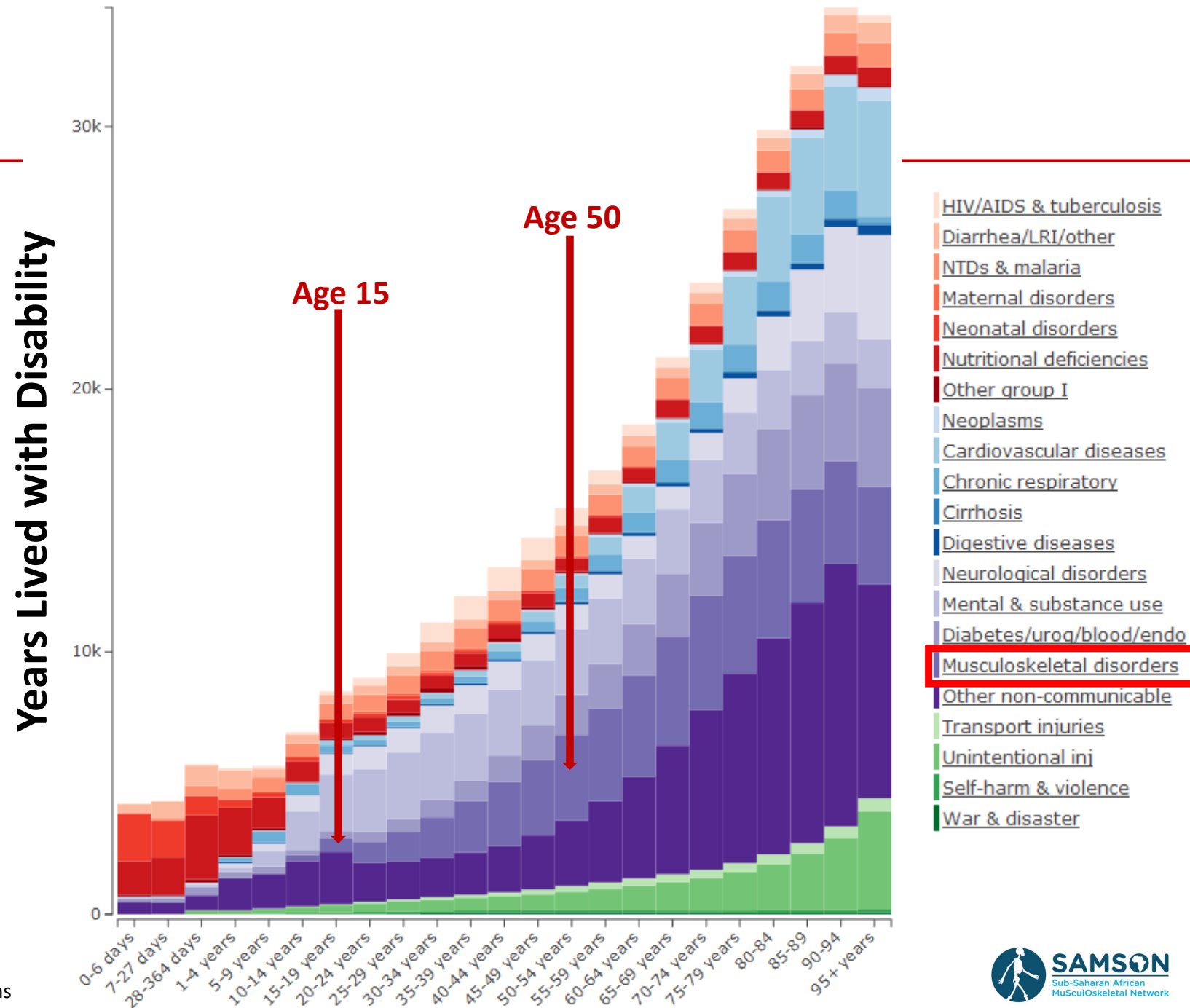


# Rates of Years Lived with Disability by age in SSA (2016)

## Musculoskeletal disorders

- Osteoarthritis
- Back pain
- Neck pain
- Rheumatoid Arthritis
- Gout
- Osteoporotic Fractures

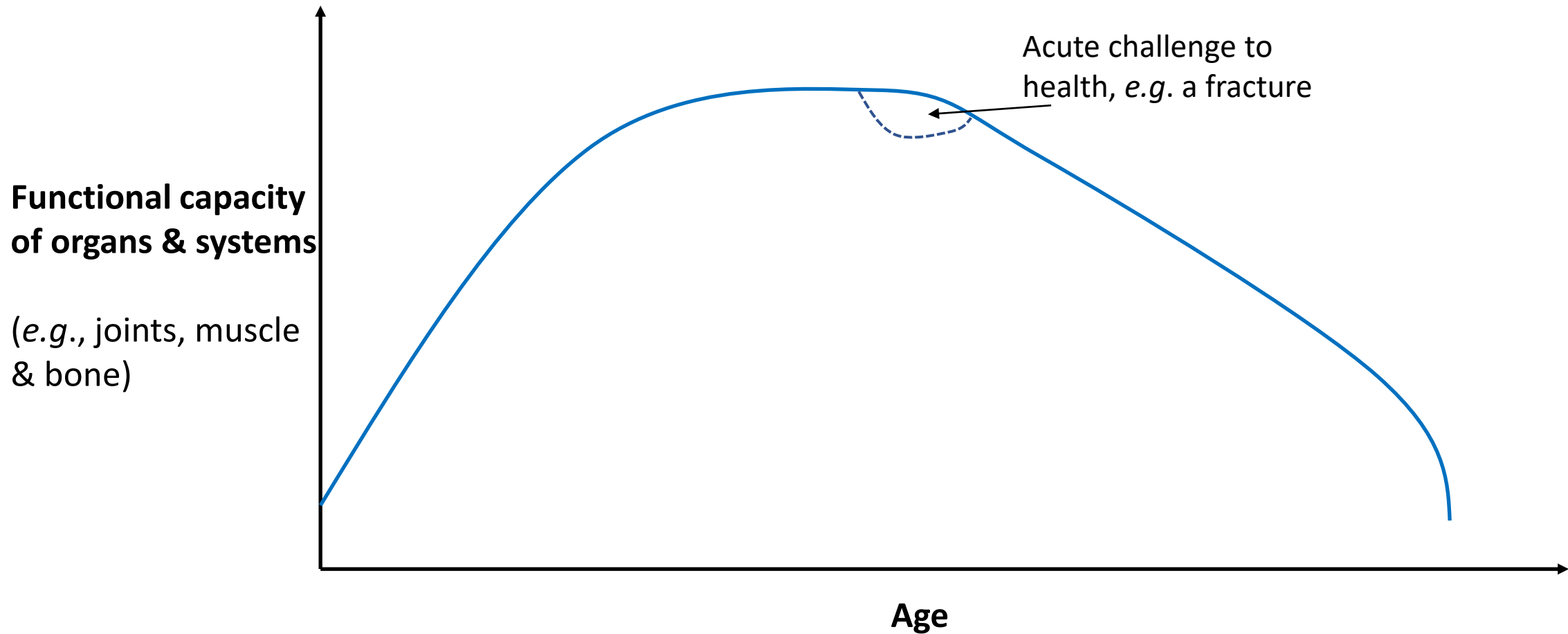
Sub-Saharan Africa, Both sexes, 2016



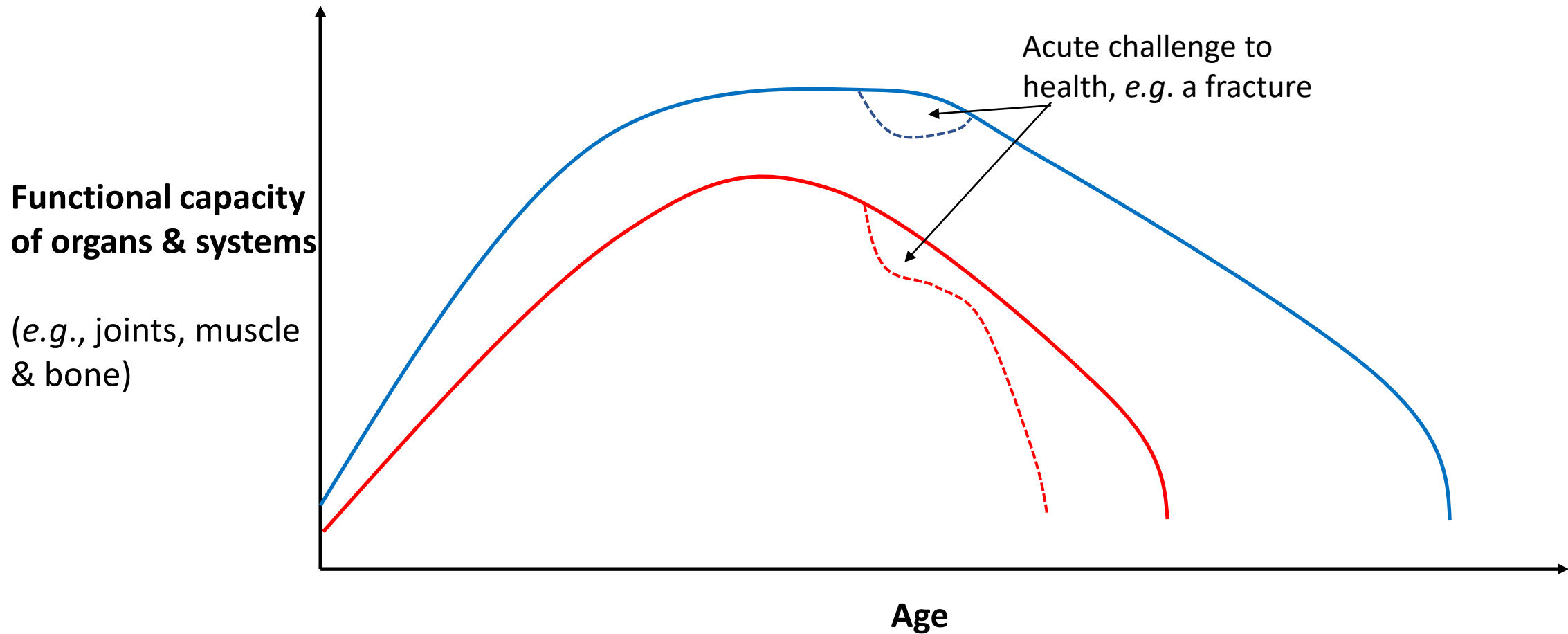
Global Burden of Disease Study 2016

<https://vizhub.healthdata.org/gbd-compare/patterns>

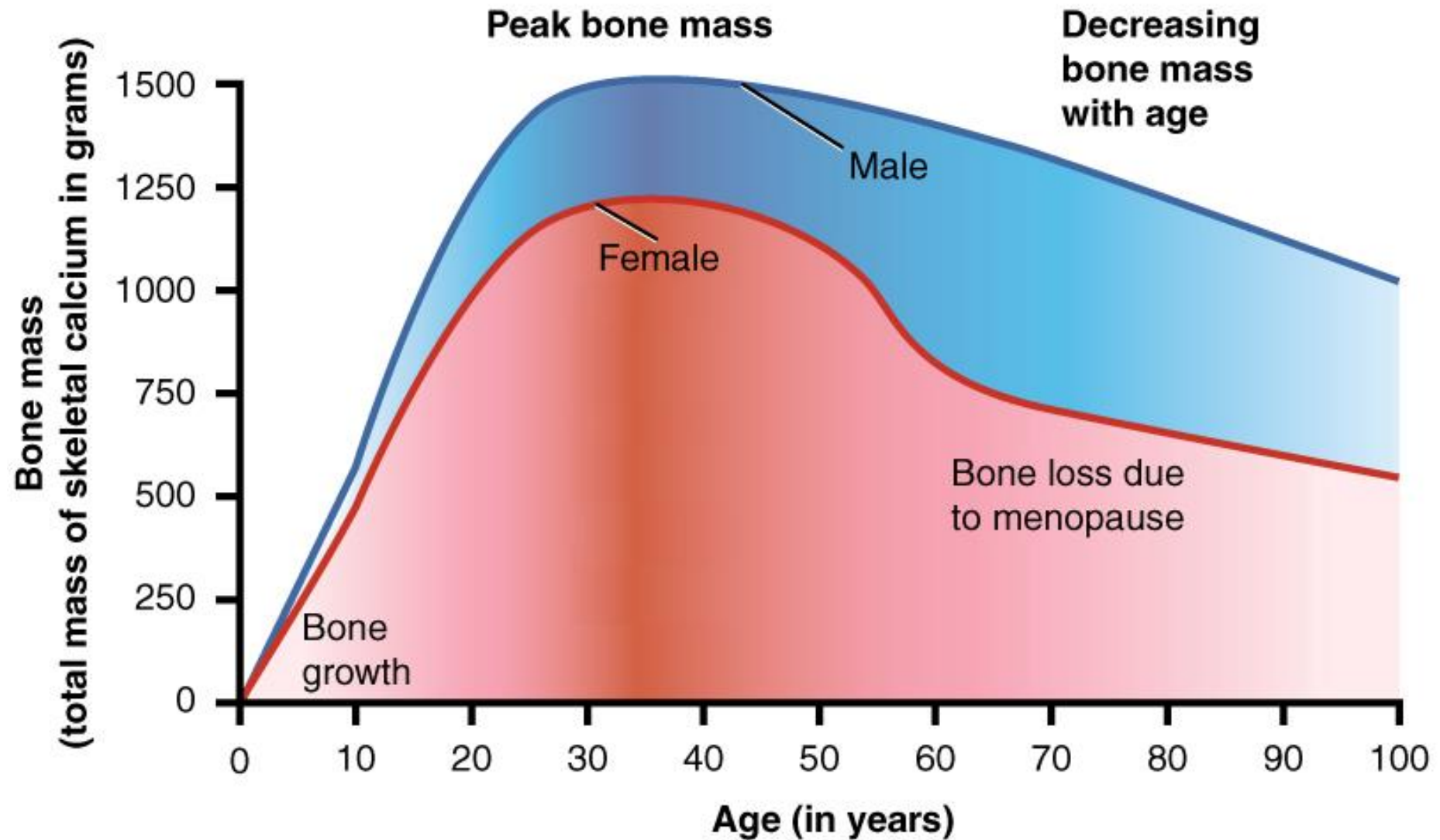
# Lifecourse model of functional capacity in high vs. low-income settings



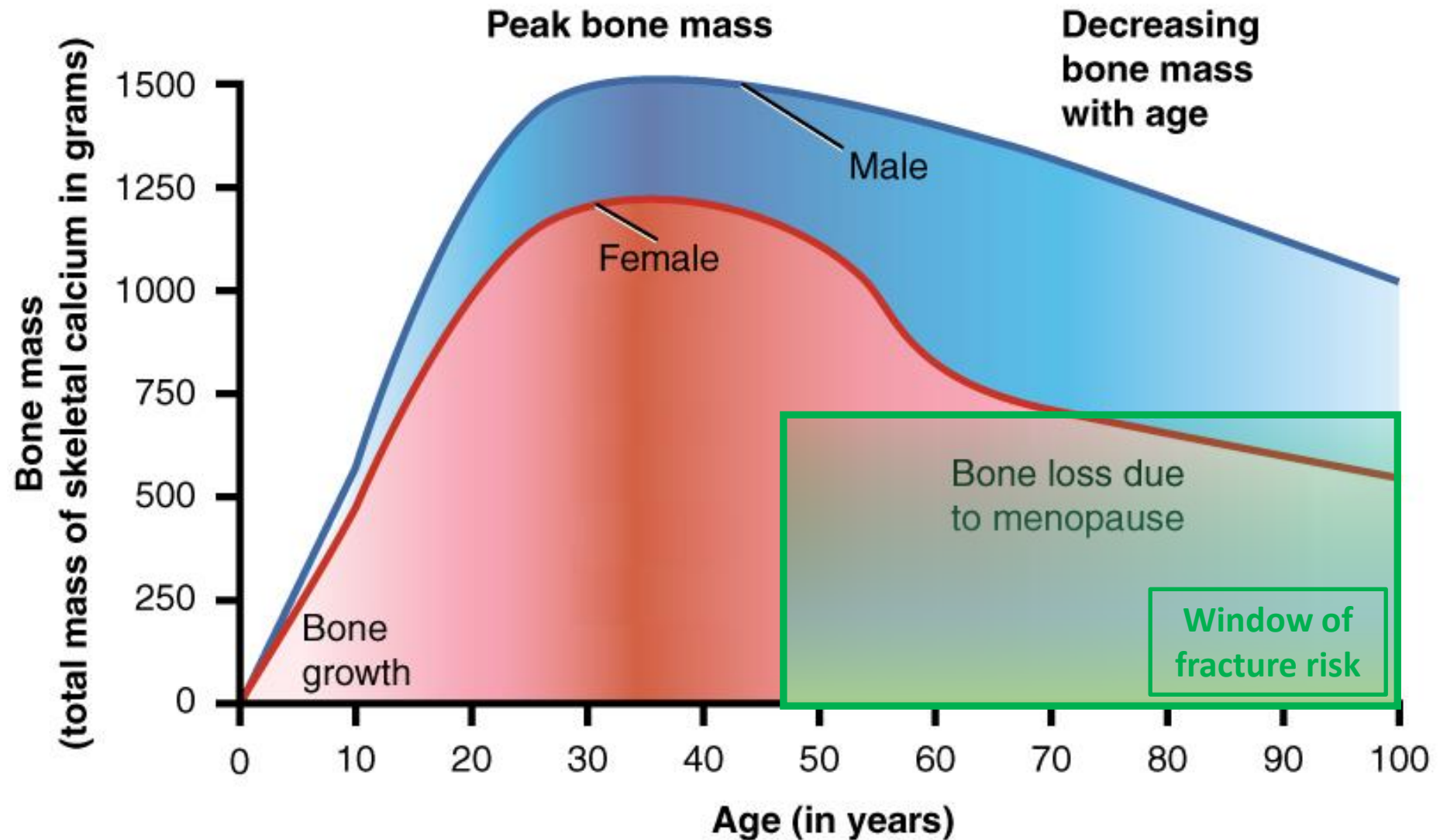
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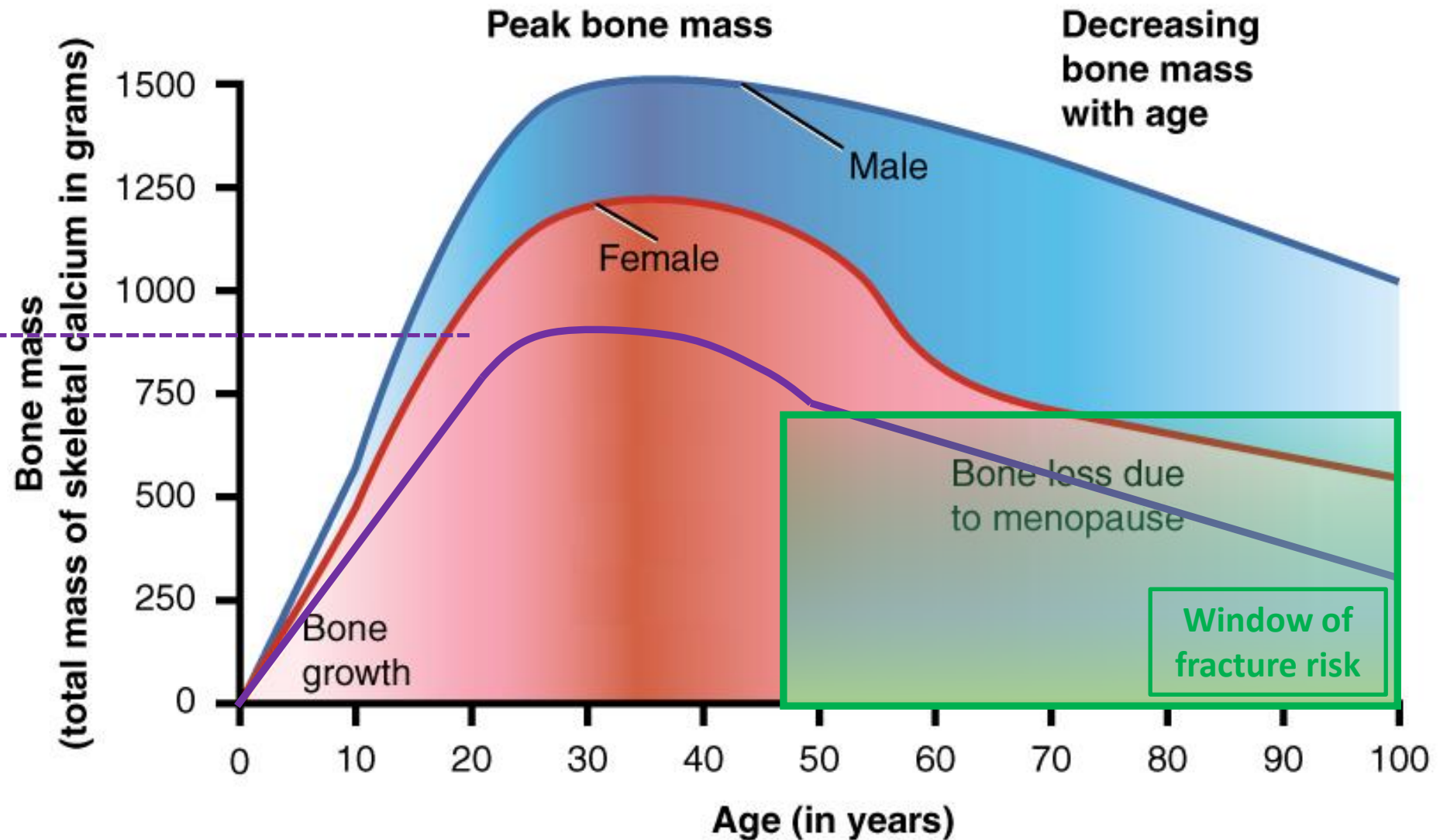
# Bone mass (& skeletal strength) through the course of life



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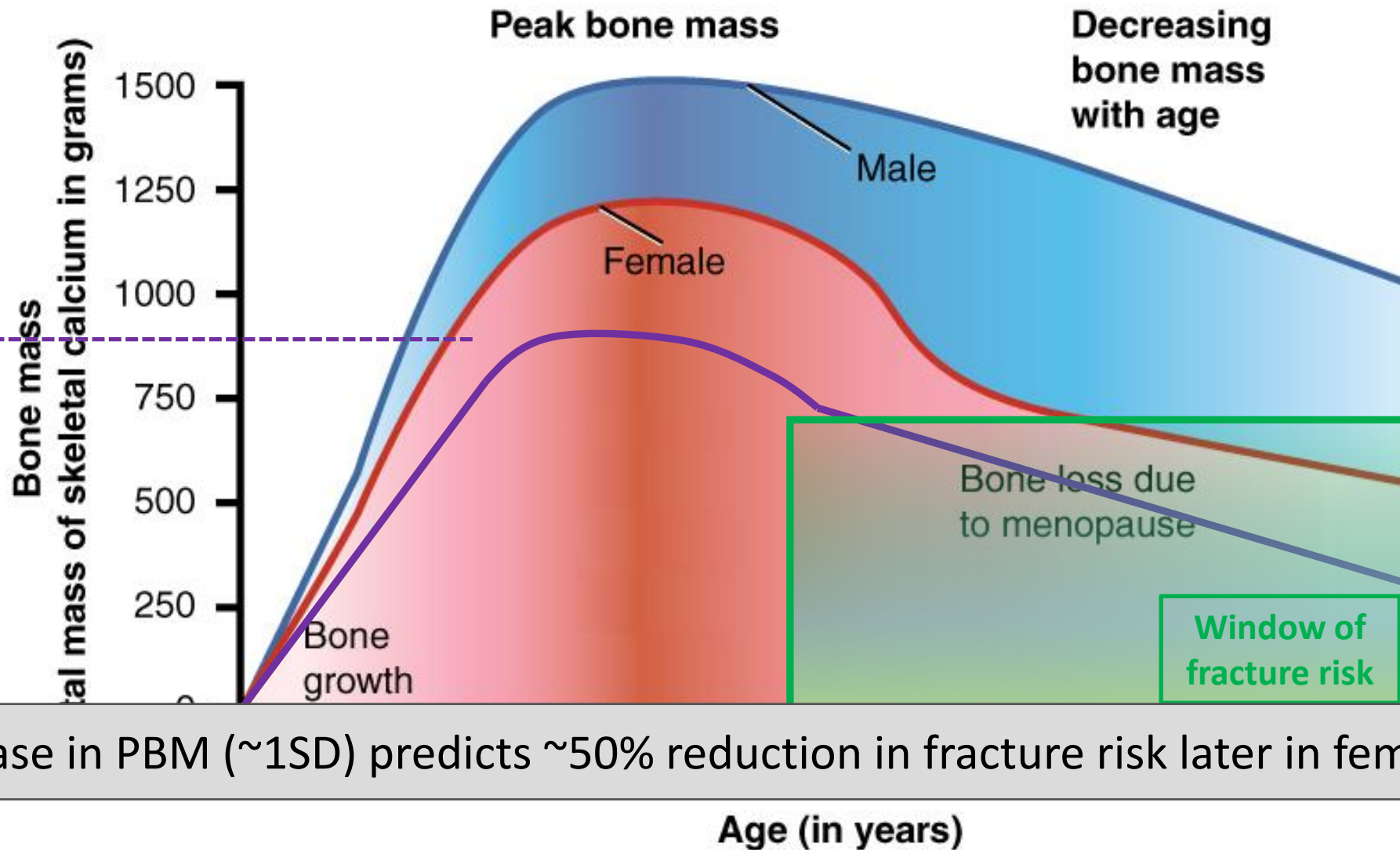
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Compromised Peak Bone Mass



# Bone mass (& skeletal strength) through the course of life

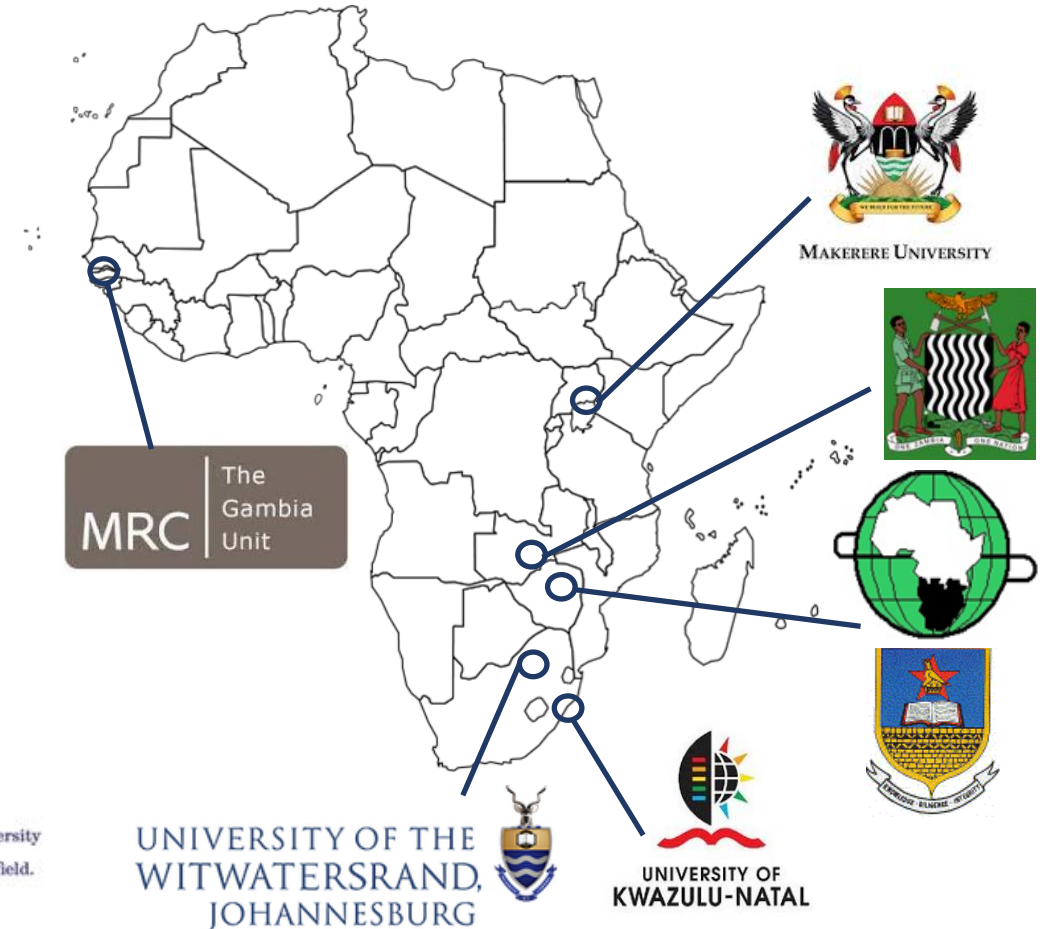


A 10% increase in PBM (~1SD) predicts ~50% reduction in fracture risk later in female life

# SAMSON; the Sub-Saharan African MuSculOskeletal Network

A network across West, East and Southern Africa which aims to;

1. **Build sustainable capacity** in Musculoskeletal Health Research by creating a collaborative research platform to share learning
2. **Inform** health policy, promote training, knowledge transfer and public engagement
3. **Provide guidance** to standardise methods for Musculoskeletal assessment across SSA



SDG3: Ensure healthy lives and promote well-being for all at all ages

# FRAGILITY FRACTURES IN SUB-SAHARAN AFRICA: THE KNOWNNS AND UNKNOWNS

Kate A. Ward <sup>1,2,3</sup>

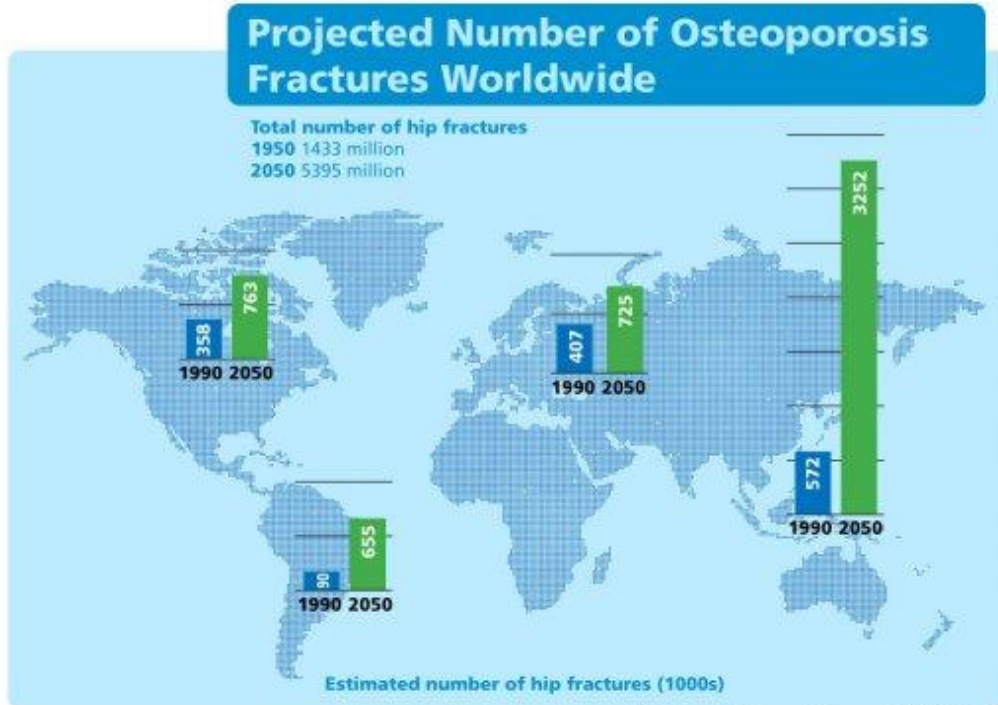
Professor of Global Musculoskeletal Health

1. MRC Lifecourse Epidemiology, Human Development and Health, University of Southampton, Southampton, UK; 2. MRC Unit The Gambia at LSHTM; 3. SAMRC Developmental Pathways for Health Research Unit, School of Clinical Medicine, University of the Witwatersrand, Johannesburg, South Africa

## Disclosures

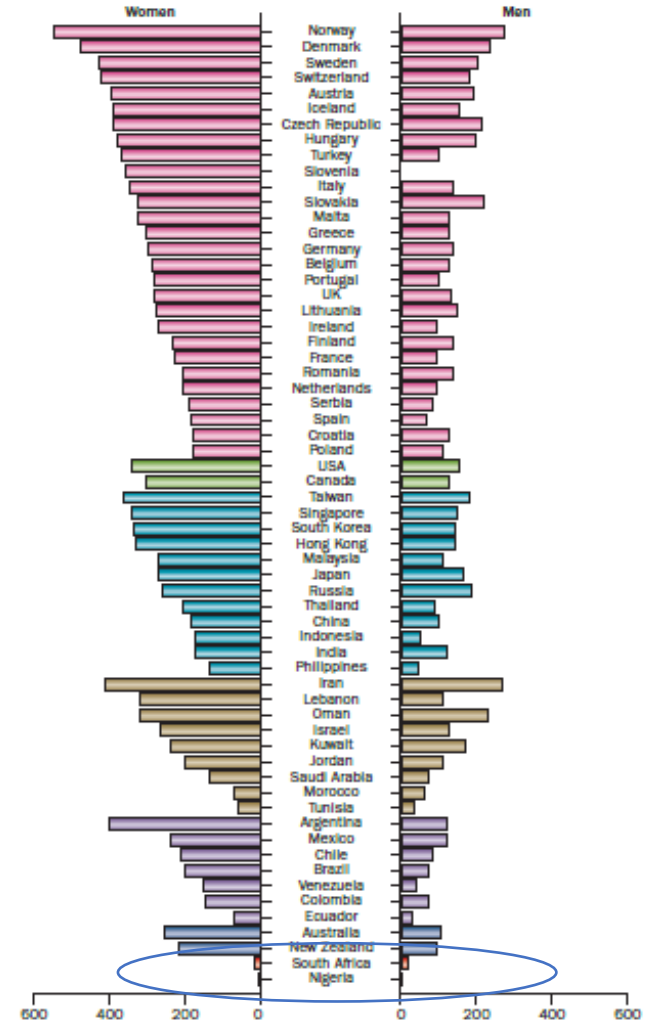
- Received speaker fees from Abbot Nutrition, Pfizer Healthcare
- Associate Editor of JBMR

# Low hip fracture incidence in SSA?



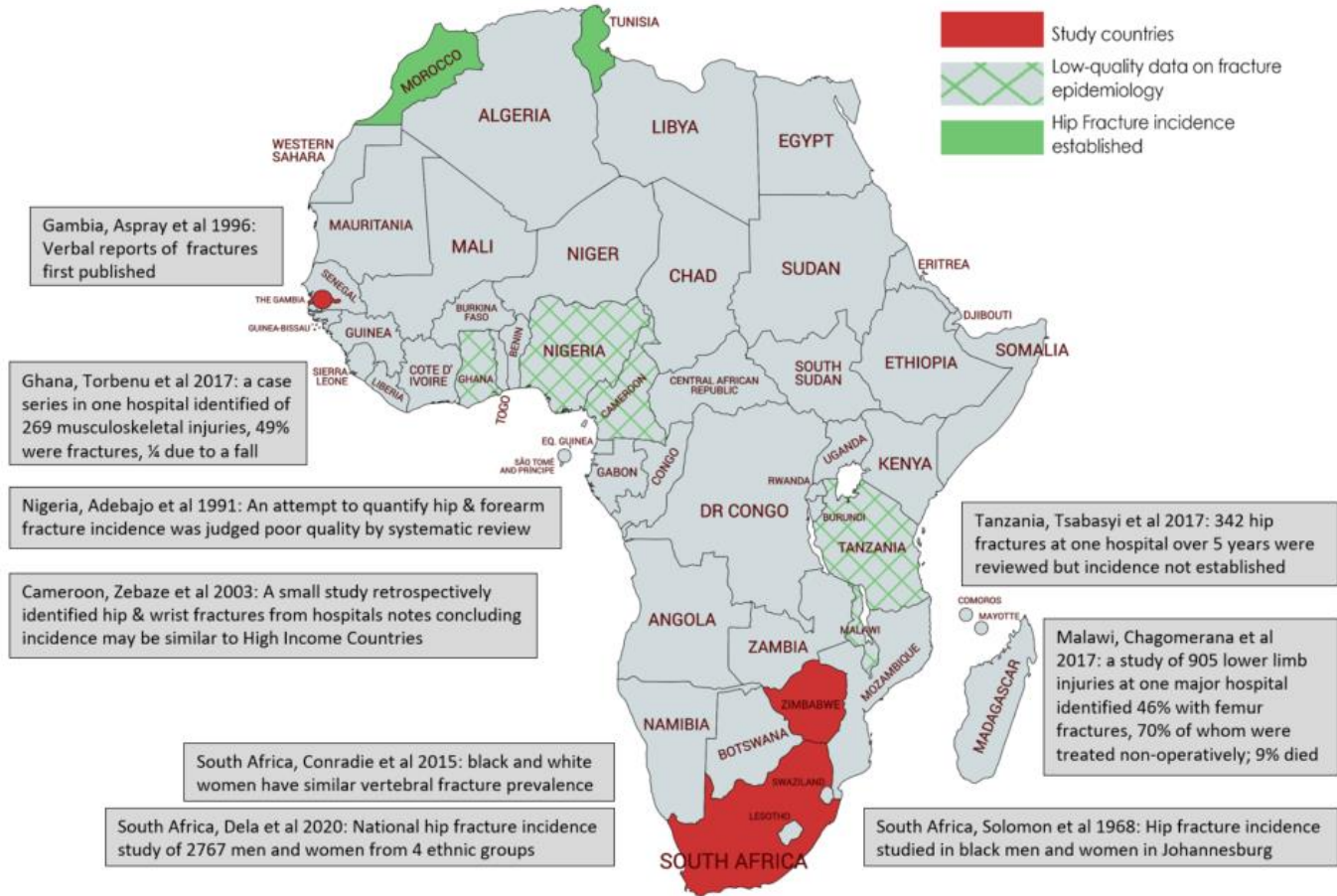
Adapted from C. Cooper et al, Osteoporos Int 1992; 2:285-9

Cooper Osteoporos Int 1992



Age-standardized hip fracture incidence (per 100,000 person-years) Cauley Nat Rev Endo 2014

# What evidence do we have?



# Ethnic- and gender-specific incidence rates for hip fractures in South Africa

- South Africa multi-ethnic population >50million
  - 79.2% African
  - 8.92 Coloured
  - 8.86 White
  - 2.49% Indian
- Gauteng, Western Cape, KwaZuluNatal
- Prospective observational study in 94 hospitals , 25 public, 69 Private sector
- Subjects aged 40years and above with a fragility fracture of the hip, neck of femur or trochanter
- 2767 subjects enrolled
- 66.3% enrolled in public sector



# Ethnic- and gender-specific incidence rates for hip fractures in South Africa

- Findings similar to other multi-ethnic populations
- Higher in women than men, except at lower ages
- IR in SA White 129.9 per 100,000 cf. UK 349 Netherlands 246 per 100,000
- IR in Africans 43.6 per 100,000 (W), 31.1 per 100,000(M) Africans, despite lowest rate of Fx, second highest # Fx in absolute terms
- >> Solomon et al. in 1960's, 4.3 and 6.9 per 100,000 W, M
- Rates in Indian population similar to those in North India, lower than Singapore Indian

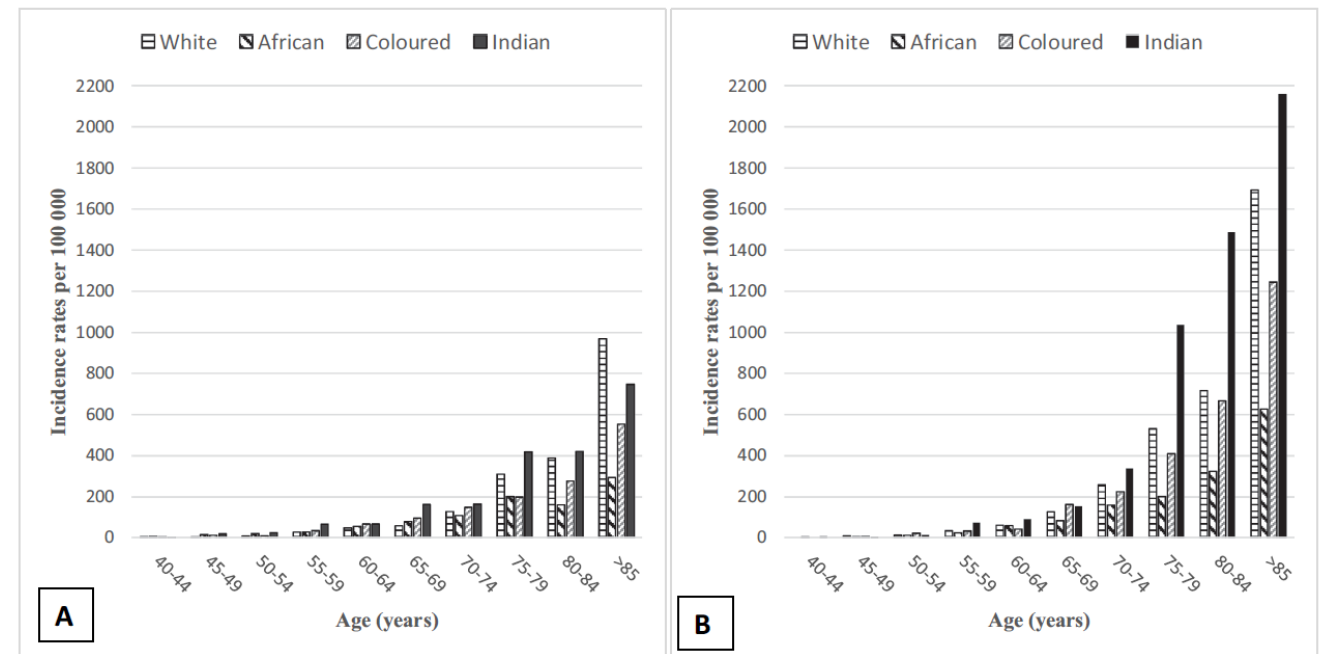


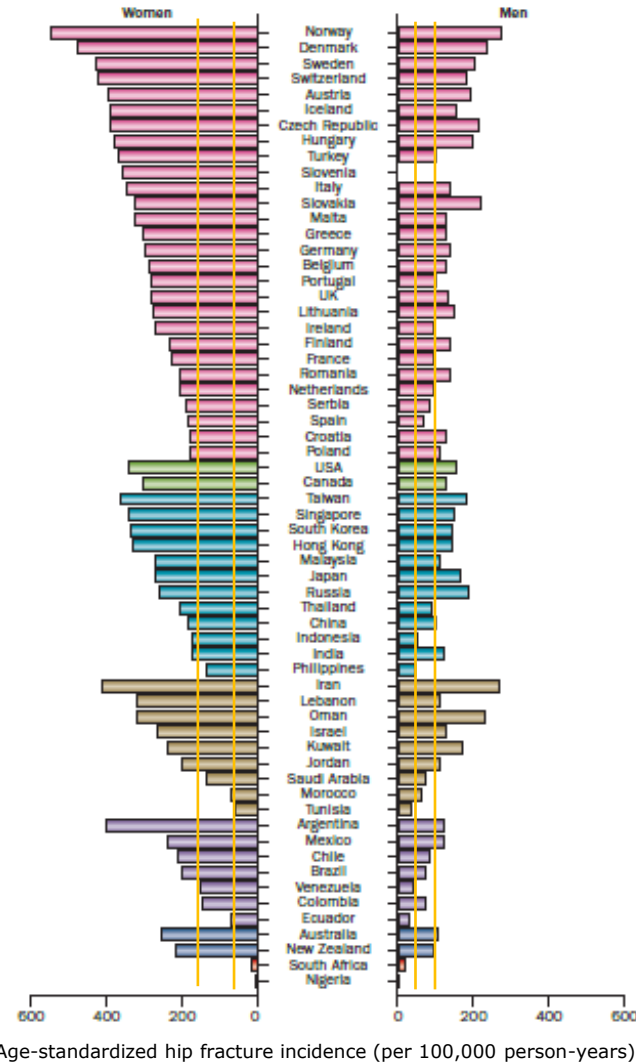
Fig. 2. Age standardised incidence rates according to ethnicity in South African men (A) and women (B).



# Hip fracture incidence in South Africa: an update

## Women:

- White 176.0 per 100,000
- Indian 147.7 per 100,000
- Coloured 73.2 per 100,000
- African 43.6 per 100,000



## Men:

- White 76.5 per 100,000
- Indian 69.2 per 100,000
- Coloured 39.7 per 100,000
- African 31.1 per 100,000

## 30-day and 1-year mortality in South Africa

- eThekweni, 5 public sector hospitals
- 200 patients, mean age 74.3y, 72% female
- 30 day mortality 13%; 1 year 33.5%, by contrast in UK 6.9%, 30% respectively
- 1y M24(41.1%) vs W 42 (30.6%) HR 0.58 (95% CI 0.27,1.29)
- 1y A 27(40.9%) vs I 33(30.0%) HR 11.5 (95% CI 1.51,2.57)
- Delays to surgery predicted death (HR 1.02, 1.00-1.05)
- Elevated serum creatinine (HR 2.43, 95%CI 1.02-5.76) and CRP (5.78, 95% CI 1.97-16.91) predicted death at 1-year

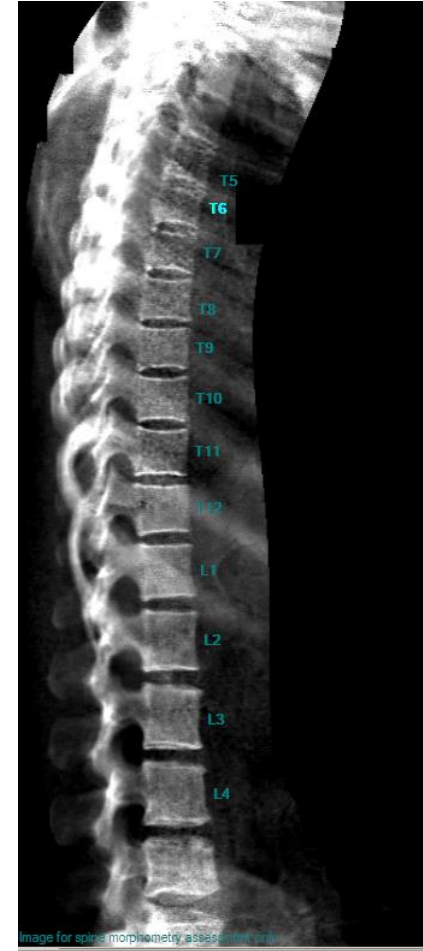
# Vertebral fracture prevalence in South Africa and The Gambia

South Africa<sup>1</sup>: (n=189, ≥40y, W)

- 9.1% African; 5.0% white
- ~60% classified as mild
- Low trauma Fx 18% (A), 11% (W)

The Gambia<sup>2</sup>: (n=488, ≥40y, M,W)

- All African
- Grade 2/3 = 9%
- Hip Fx (self report) 3% W, 0.4% M

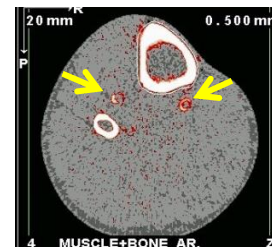


# Gambian Bone Ageing Study (GamBAS)

- Prospective study, M&F, 8, 5yr age range bands - 40 to 75+. Stratified by age band and gender, randomised follow-up 1.5 to 2 years. 240 per gender, ~ 30 per age band
- DXA (+LVA), pQCT, jumping mechanography and grip strength. Fasting bloods, 2hr & 24hr urine, lifestyle and medical history
- Baseline; n=488 (227M, 262F); Follow-up 1; n= 386 (468); FU2 – 270
- GamBAS Urban pilot, 60-80y olds n=101 (51F), plus knee radiographs

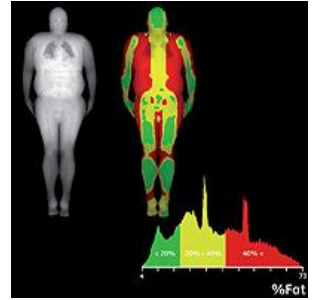


- Fractures in 9% LVA scans, osteophytes 14%
- Sarcopenia prevalence 45% women: 20% men. Needs new definition
- NCD comorbidity: Sex differences in markers of poorer cardiovascular health and lower BMD, present in women but not men
- Peripheral vascular calcification associated with lower BMD in women
- Bone loss similar magnitude to HIC's



## Sarcopenia in older Gambian adults: *new definitions required*

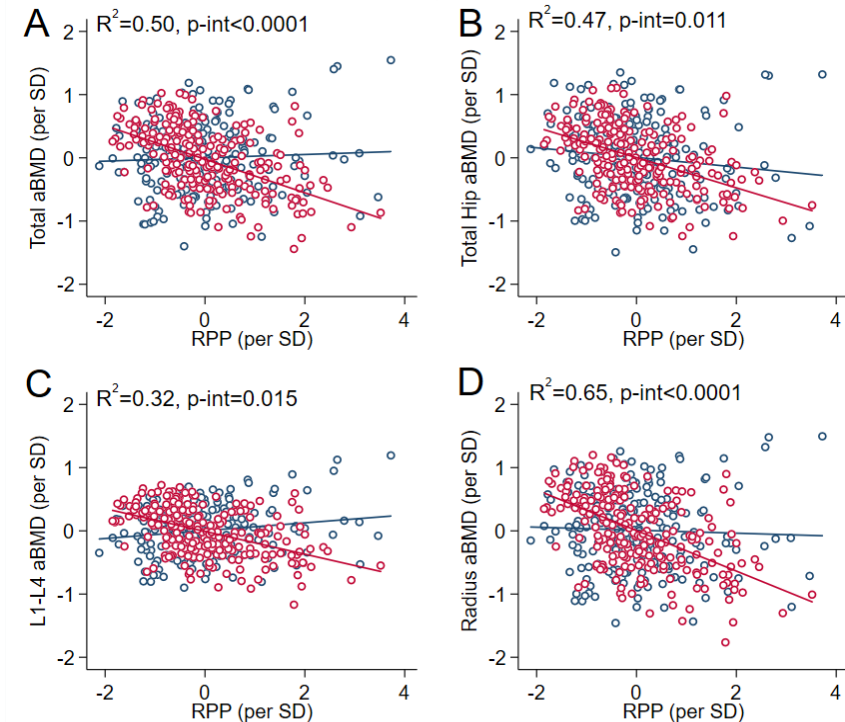
- FNIH ALM had best sensitivity and specificity to predict poor grip and lower limb function; in women ~70% .
- FNIH ALM in men 40% sensitivity, 90% specificity
- FNIH: 45% (68%) women: 20% (81%) men
- EWGSOP: 10% (85%) women: 19% (82%) men
- Sensitivity poor, 20-40%; specificity 90%.
- Associations between muscle force and bone outcomes
- Highlights importance of not applying definitions across diverse populations



# Non communicable disease of ageing: *Cardiac workload, BMD & body composition in Gambian adults*



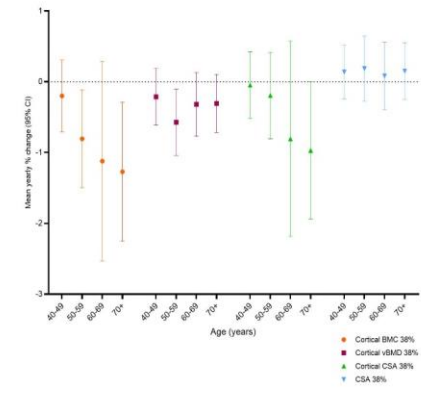
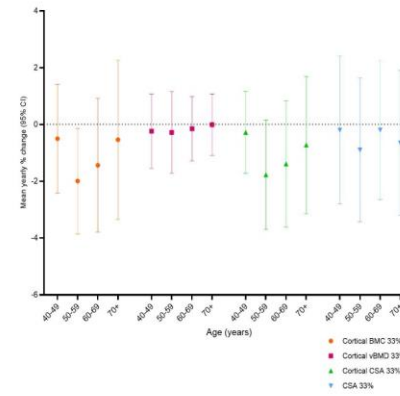
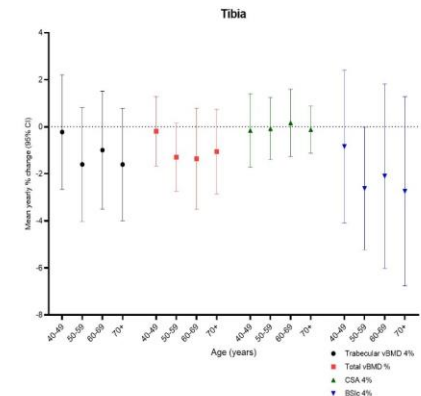
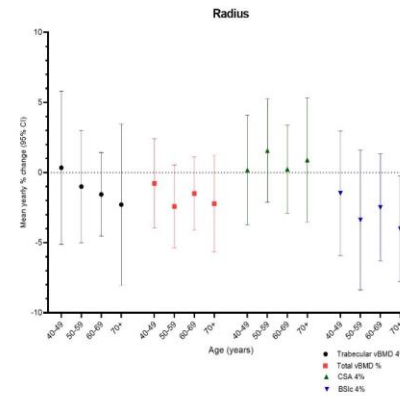
- Rate pressure product (myocardial oxygen consumption) and pulse pressure (arterial stiffness)
- Sex differences in the associations between cardiac workload and aBMD
- Higher RPP, lower aBMD in women, similar results with PP
- Women but not men with PVC had lower aBMD
- With rising CVD in ageing populations, need to identify common preventative strategies



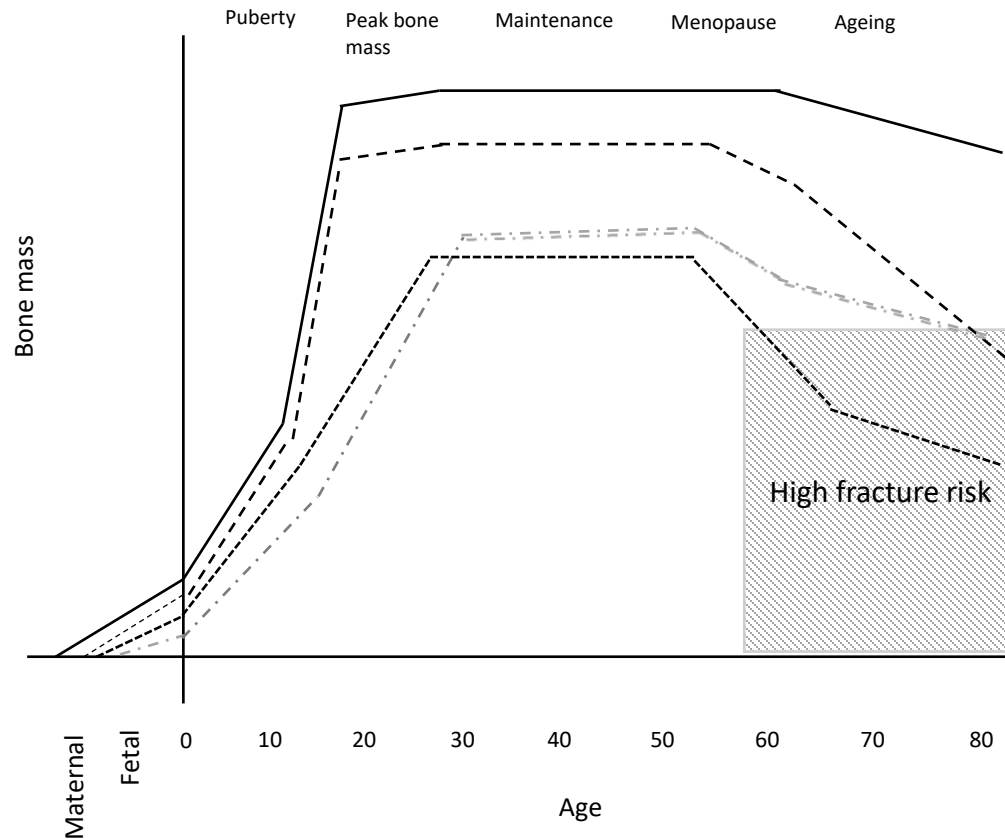
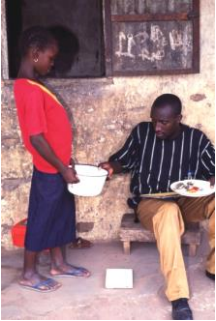


# Predictors of change in bone with ageing GamBAS

- Advancing age was the main predictor of skeletal change in this population – the magnitude of which was in keeping with data from high-income countries.
- In women, CTX and P1NP were strongly associated with decreases in trabecular vBMD.
- Better muscle function was associated with less change in bone, and hence better bone health with ageing, though no consistent patterns found



# Environment, pubertal timing and future bone health



- Timing of puberty a known risk factor for future fracture risk
- Age at peak velocity: M Ca 14.4, P 14.8 y; F Ca 13.3, PI 13.2y
- There were transient increases in BMC after Ca supplementation in a population accustomed to low calcium intake
- In boys, puberty was consistently earlier in the calcium group compared to the placebo group; Ca boys were shorter at the end of the growth
- No supplement effect on puberty in girls
- No persisting effect of calcium supplementation on BMD in boys or in girls who are accustomed to low dietary calcium intakes.

Dibba AJCN 2000;71;

Dibba AJCN 2002;76;

Prentice AJCN 2012;96;

Ward JCEM 2014

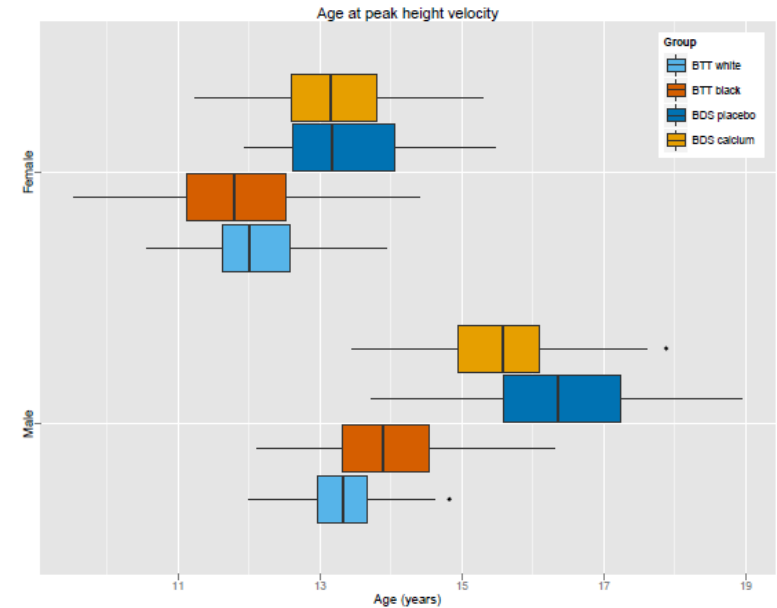
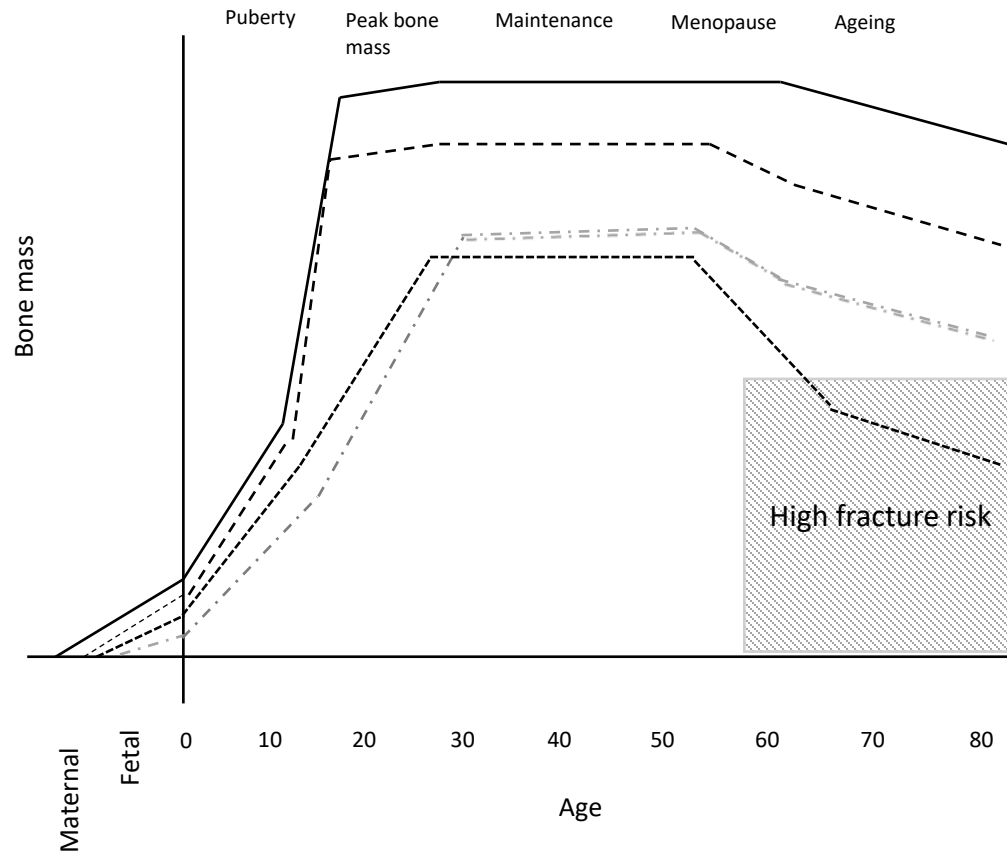
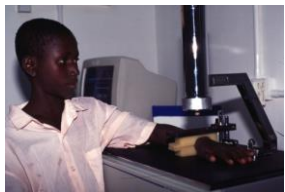
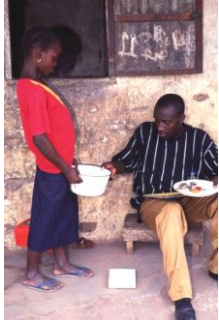
Ward JBMR S1, 2014

Ward, Proc Nut Soc 2012

Schoenbuchner PhD University of Cambridge 2016



# Environment, pubertal timing and future bone health



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# Children living with HIV in Zimbabwe have impaired bone architecture, despite treatment with anti-retroviral therapy: a cross-sectional study

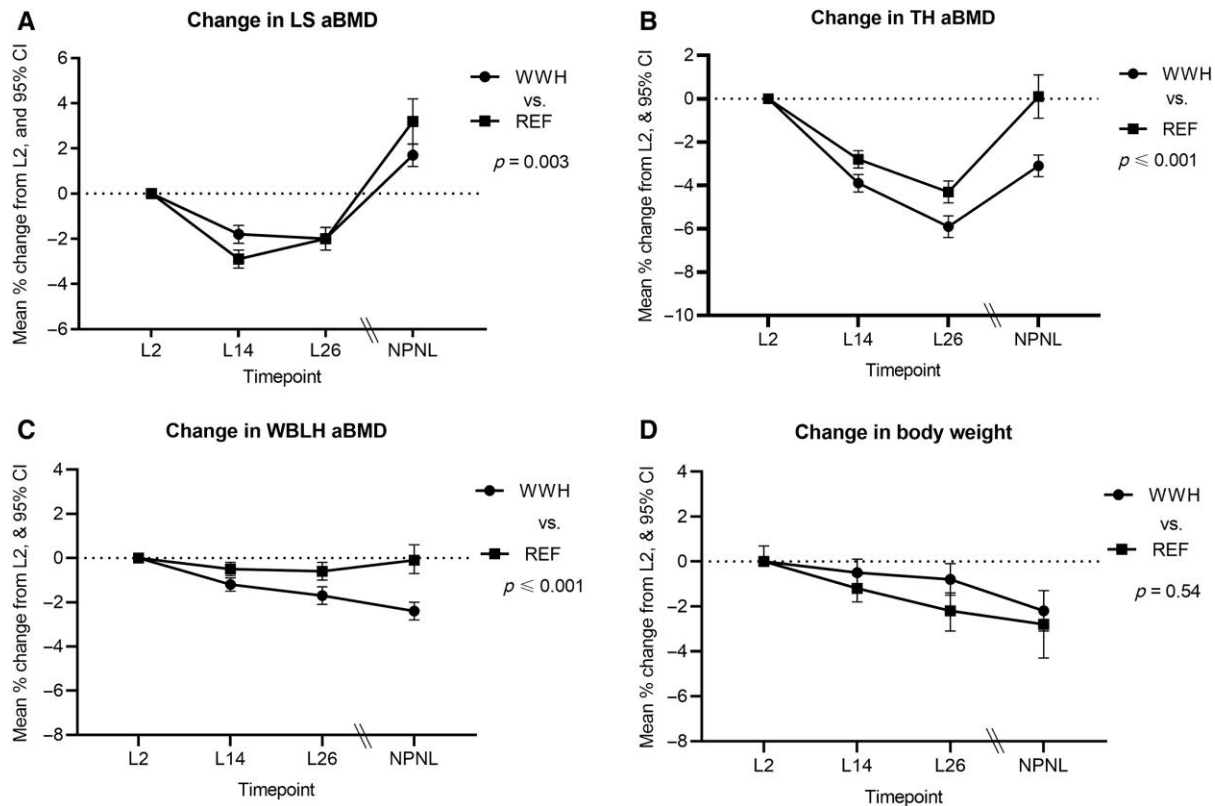
## The IMVASK pQCT Study

- Harare, Zimbabwe
  - HIV+ and HIV- Children and Adolescence
  - 8 to 16 years old,
  - Established on ART (>2y)
  - From Parirenyatwa and Harare Hospital clinics (HIV+); from schools within the same catchment area (HIV-)
  - Frequency matched for age and sex
  - 273 (HIV+) and 298 (HIV-)
- There are deficits in bone size in both boys and girls living with HIV who in the later stages of puberty
  - There are deficits in predicted bone strength in children with HIV infection who are in the later stages of puberty
  - This study population is currently in follow-up; longitudinal data will show us whether or not deficits attenuate with age
  - c

**Aim:** To compare the bone density, bone size and predicted bone strength parameters of trabecular and cortical bone in children and adolescents living with and without HIV in Harare, Zimbabwe

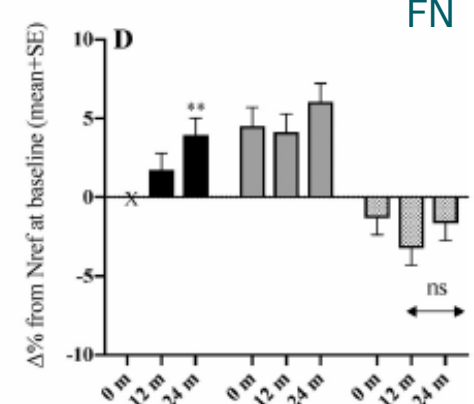
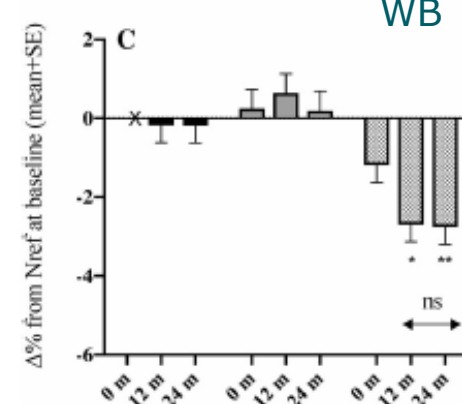
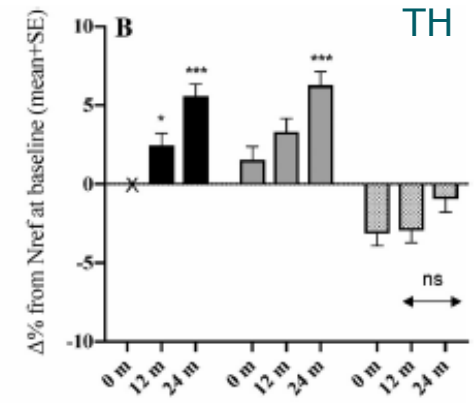
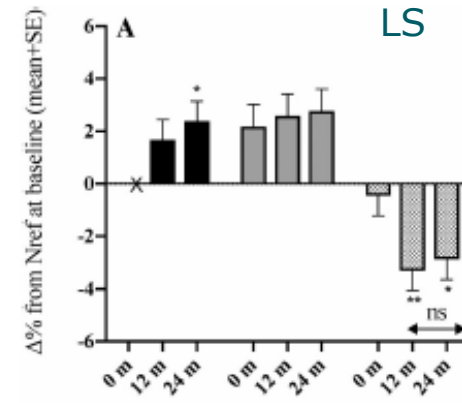
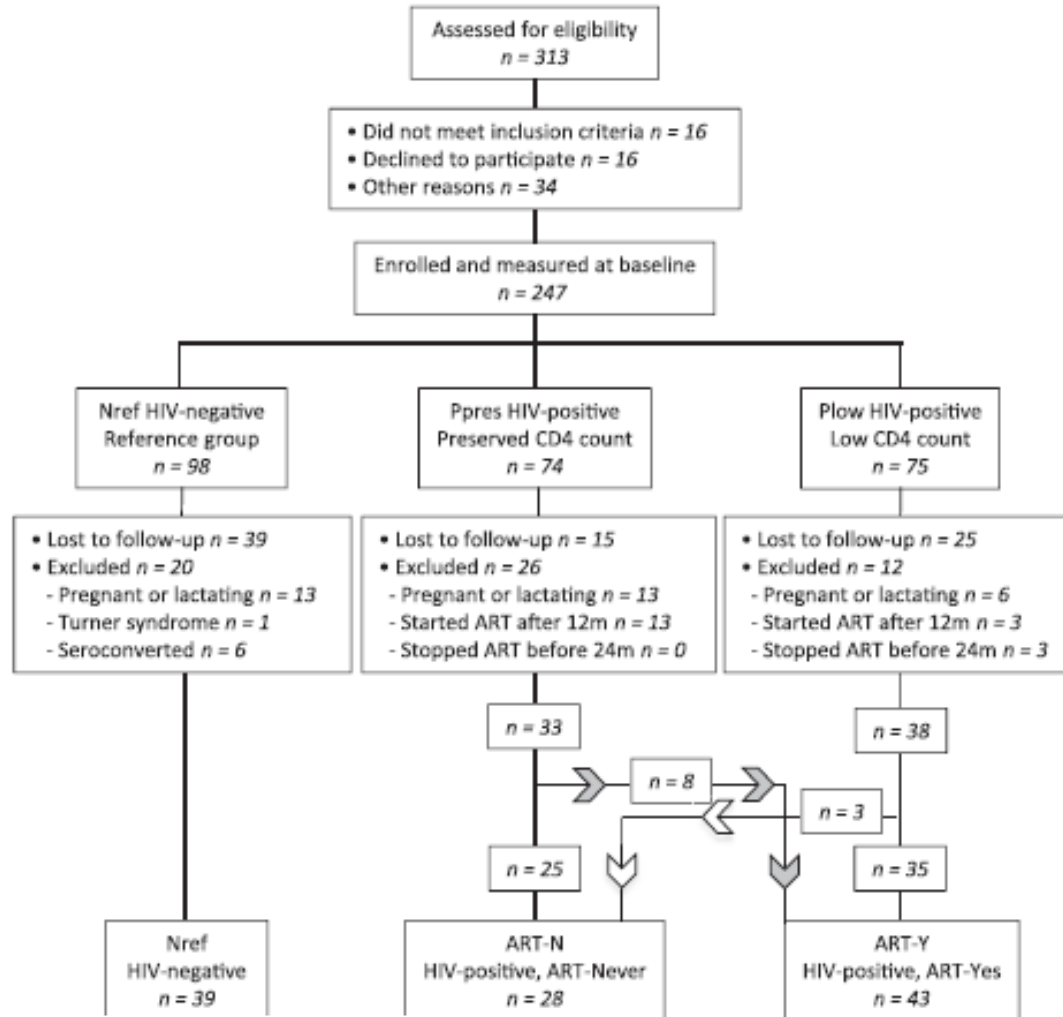
# Bone loss and lactation in Women Living with HIV: Potential Implications for Long-Term Bone Health

Changes in Bone Mineral Density During and After Lactation in Ugandan Women With HIV on Tenofovir-Based Antiretroviral Therapy

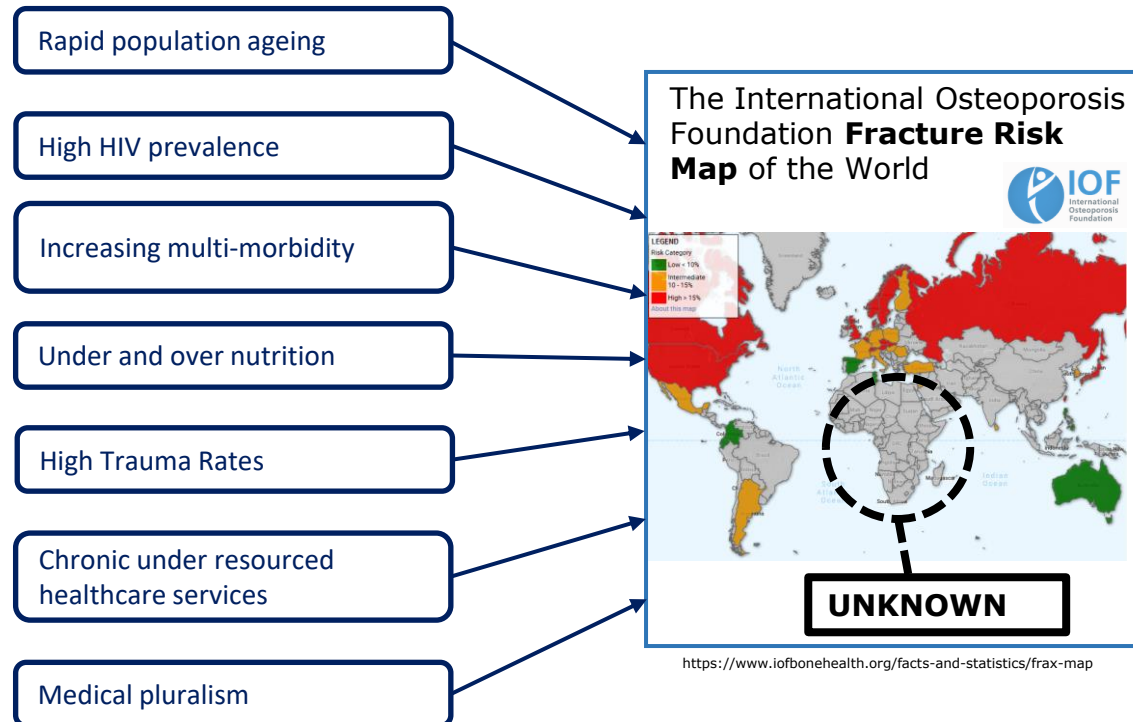


- Pregnancy and lactation associated with loss of BMD
- Women newly diagnosed with HIV and initiated on ART
- 426 pregnant women (210 WWH; 216 REF)
- Consistent decreases in aBMD in first 6mo
- TH and WBBMD did not return to L2 levels when women were NPNL
- LS aBMD losses similar in WWH and REF, and recovered in both groups.
- Accentuated bone loss evident in WWH, with only partial recovery in the hip and whole body

# HIV, treatment and BMD in South Africa

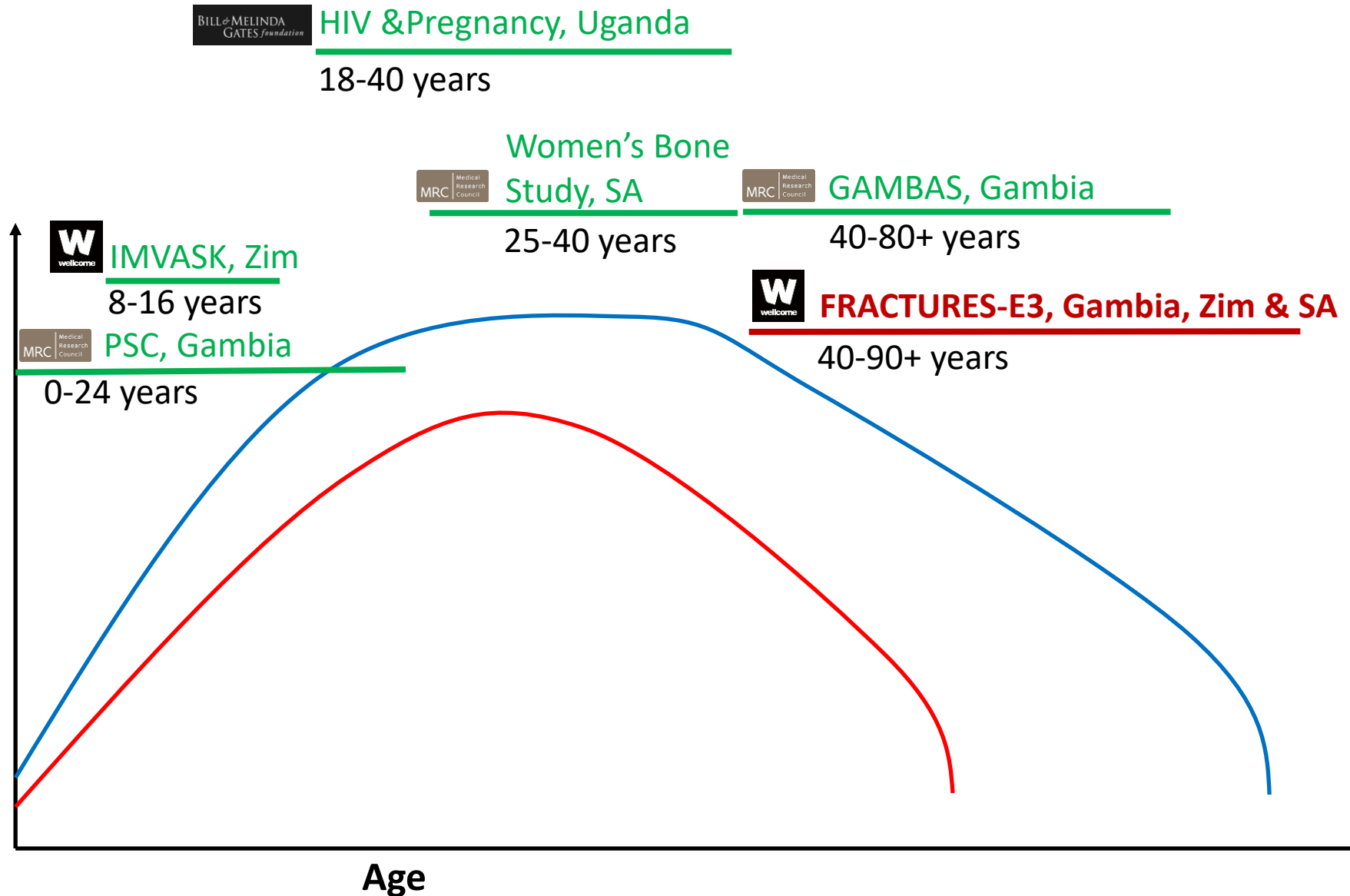


# Fractures in sub-Saharan Africa: Epidemiology, economic impact and ethnography



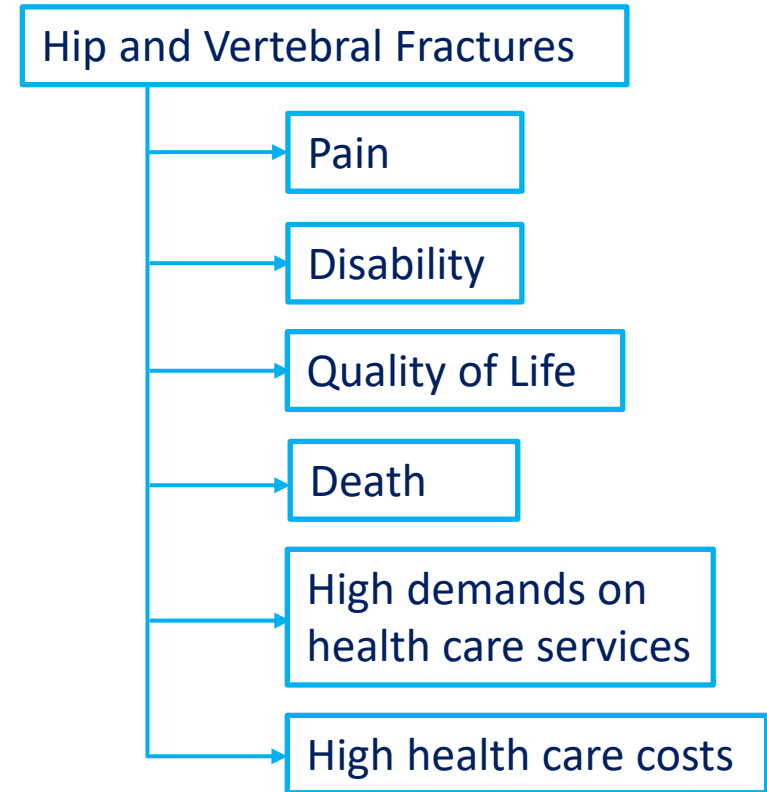
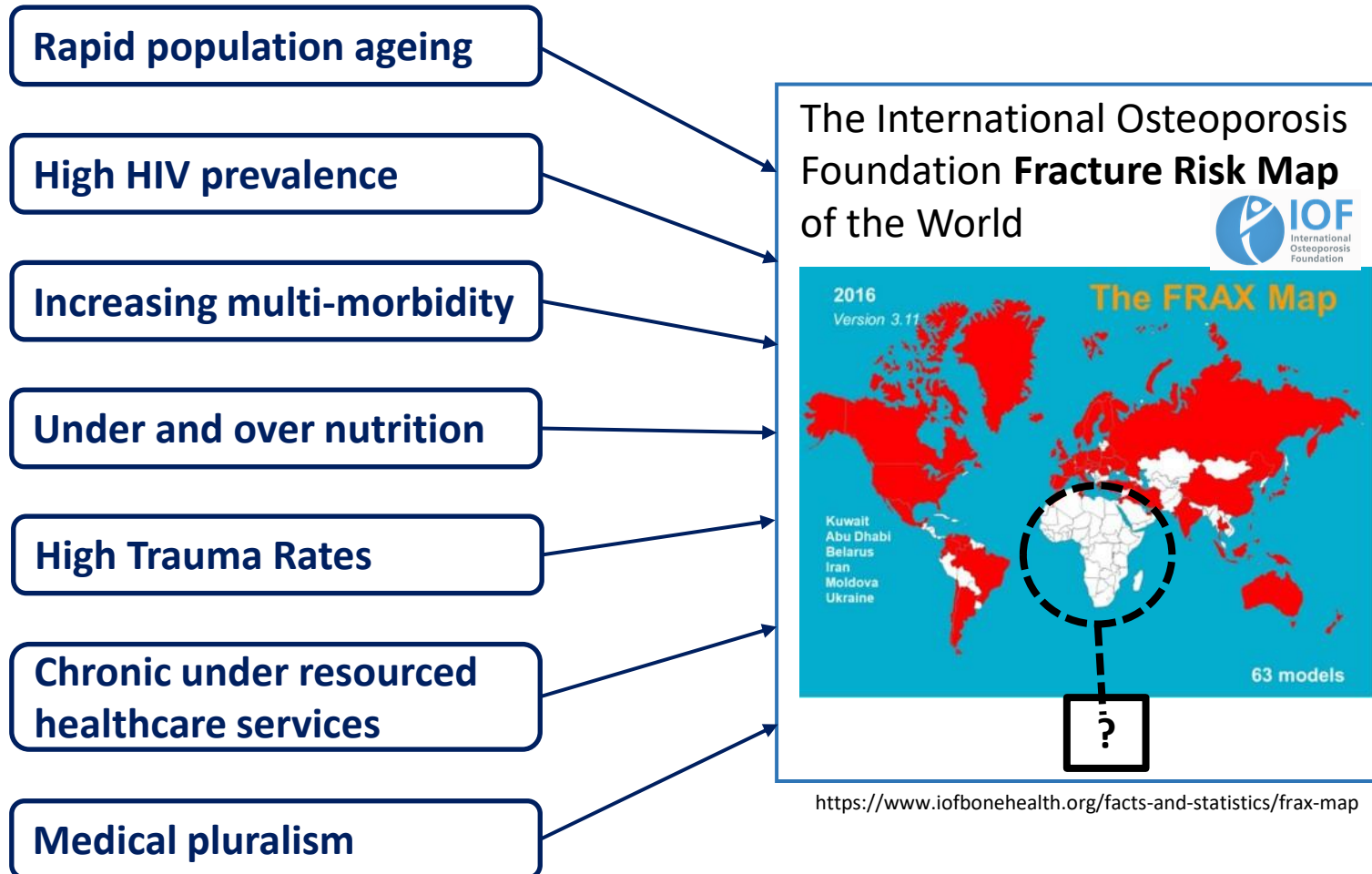
# There is a need to investigate musculoskeletal ageing, including fractures, in older populations in West, Southeast and Southern Africa

Functional capacity of the musculoskeletal systems

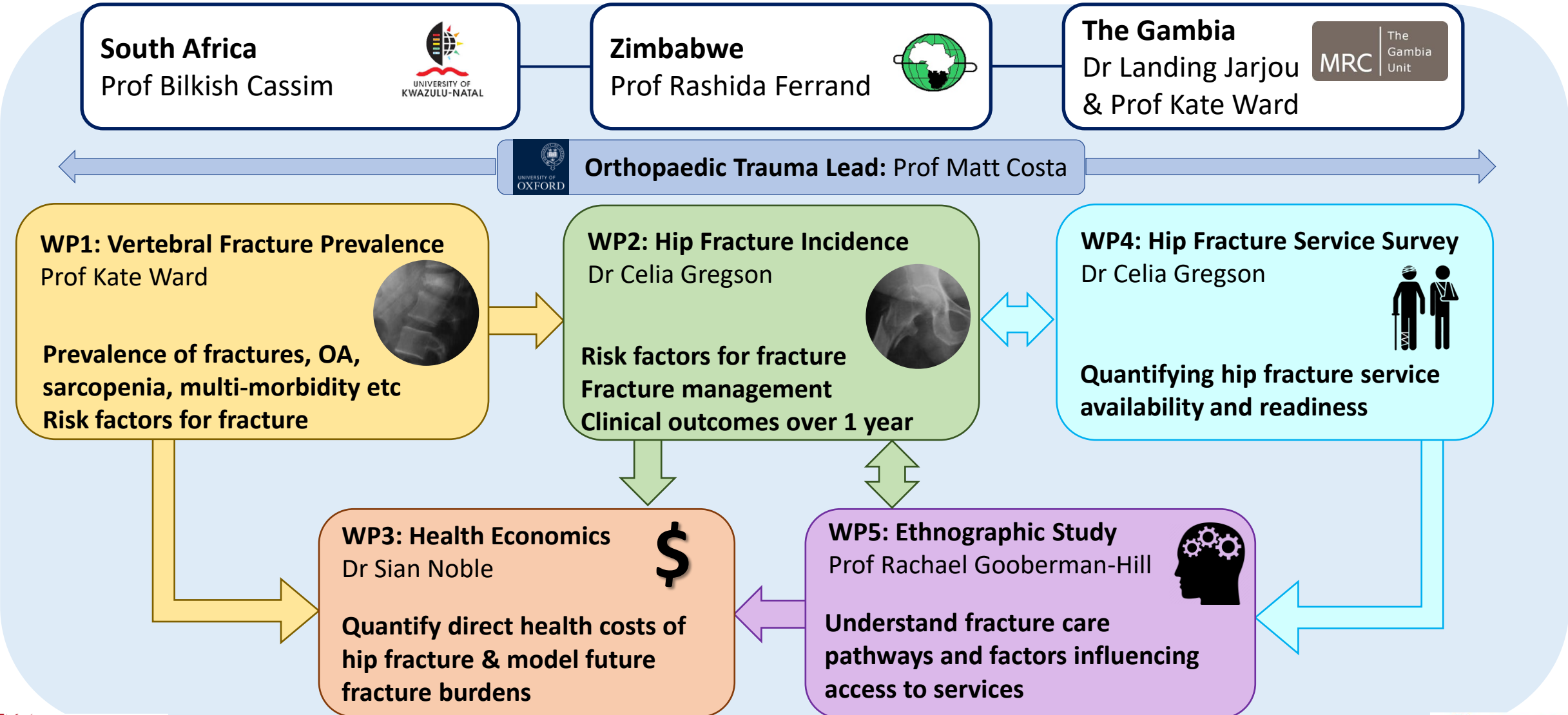
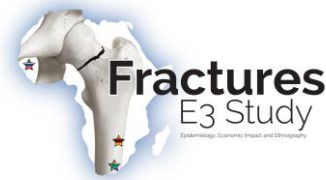


Adapted from Hansen et al. *J Physiol.* 2016. 594(8): 2147-60

# Fractures in sub-Saharan Africa: Epidemiology, economic impact and ethnography (E<sup>3</sup>)

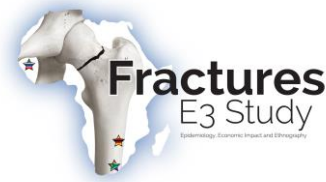


# Fractures-E<sup>3</sup>: Five workpackages over 5 years (2020-25)





# The Fractures-E<sup>3</sup> country team leads



**South Africa**  
Prof Bilkish Cassim  
Head of the Department  
Geriatrics, University of  
Kwazulu-Natal



**Zimbabwe**  
Prof Rashida Ferrand  
Professor of International  
Health, Biomedical Research and  
Training Institute

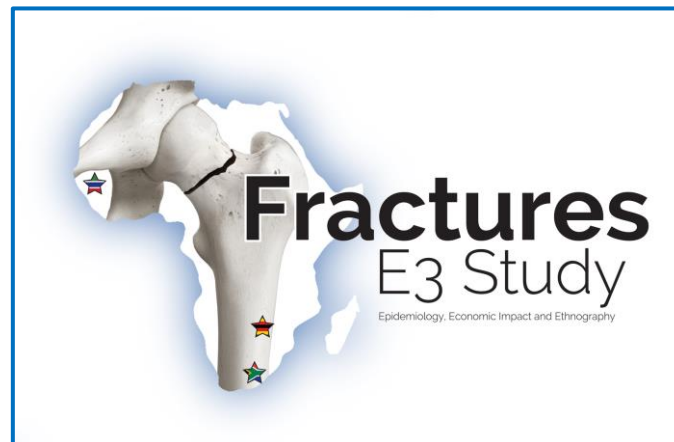
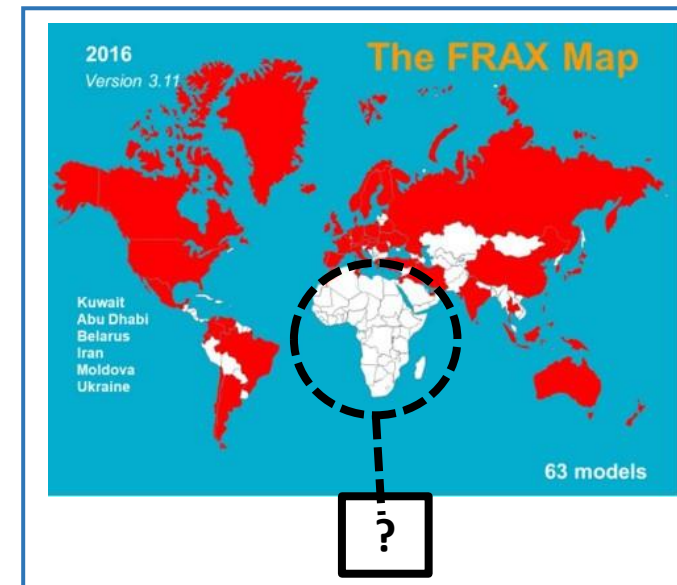
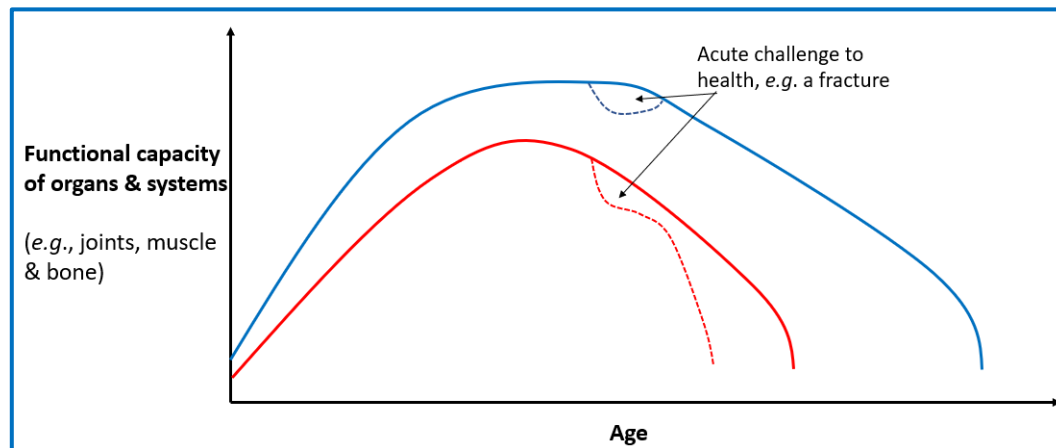
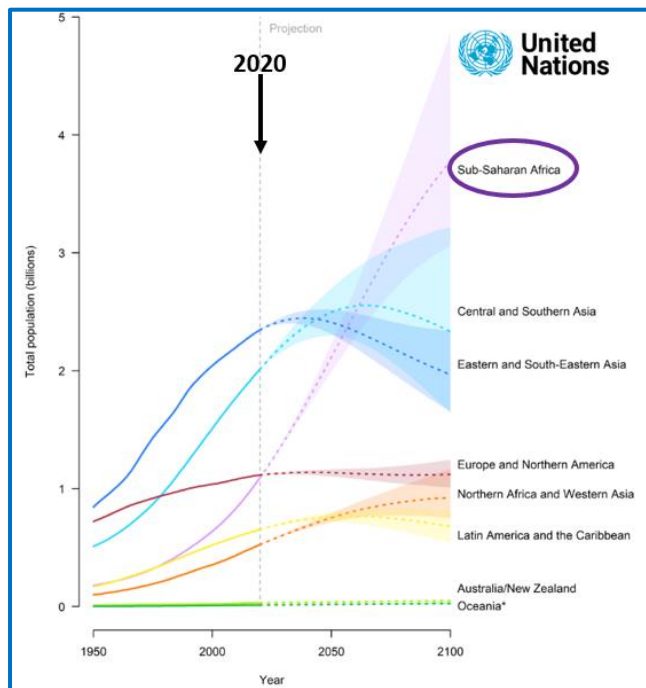


**The Gambia**  
Dr Landing Jarjou  
Head of Calcium, Vitamin D &  
Bone Health at MRC Unit  
The Gambia



1. Calibration of fracture risk assessment tool (FRAX) for use in Africa (with clinical guidelines)
2. Develop fracture registries for use across SSA
3. Evidence to support inclusion of osteoporosis treatment as WHO Essential Medicines
4. Multidisciplinary research capacity development
5. Understanding of current fracture service provision, current and projected musculoskeletal burdens to inform the planning of future health service provision

# Conclusions



# Acknowledgements

## South Africa

Bilkish Cassim  
Mkhululi Lukhele  
Farhanah Paruk  
Yoliswa Madela  
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Collen Masimirembwa  
Brian Paketh  
Suzanne Wedner



## The Gambia

Landing Jarjou  
Kebba Marenah  
Kate Ward



## UK

Celia Gregson  
Kate Ward  
Matt Costa  
Sian Noble  
Rachael Gooberman-Hill  
Sarah Drew  
Nyasha Mafirakureva  
Anya Burton  
Sam Hawley  
Simon Graham



[Celia.Gregson@bristol.ac.uk](mailto:Celia.Gregson@bristol.ac.uk)  
[kw@mrc.soton.ac.uk](mailto:kw@mrc.soton.ac.uk)

<https://www.bristol.ac.uk/translational-health-sciences/research/musculoskeletal/rheumatology/research/global-musculoskeletal-health/>