Epidemiology of Central & Peripheral Arterial Disease in Chronic Kidney Disease

Professor Gerry Fowkes
Usher Institute of Population Health Sciences
University of Edinburgh

DISCLOSURES

- None relevant to this presentation

Scope and Definition

Peripheral Arterial Disease

- Lower Limb

Central Arterial Diseases

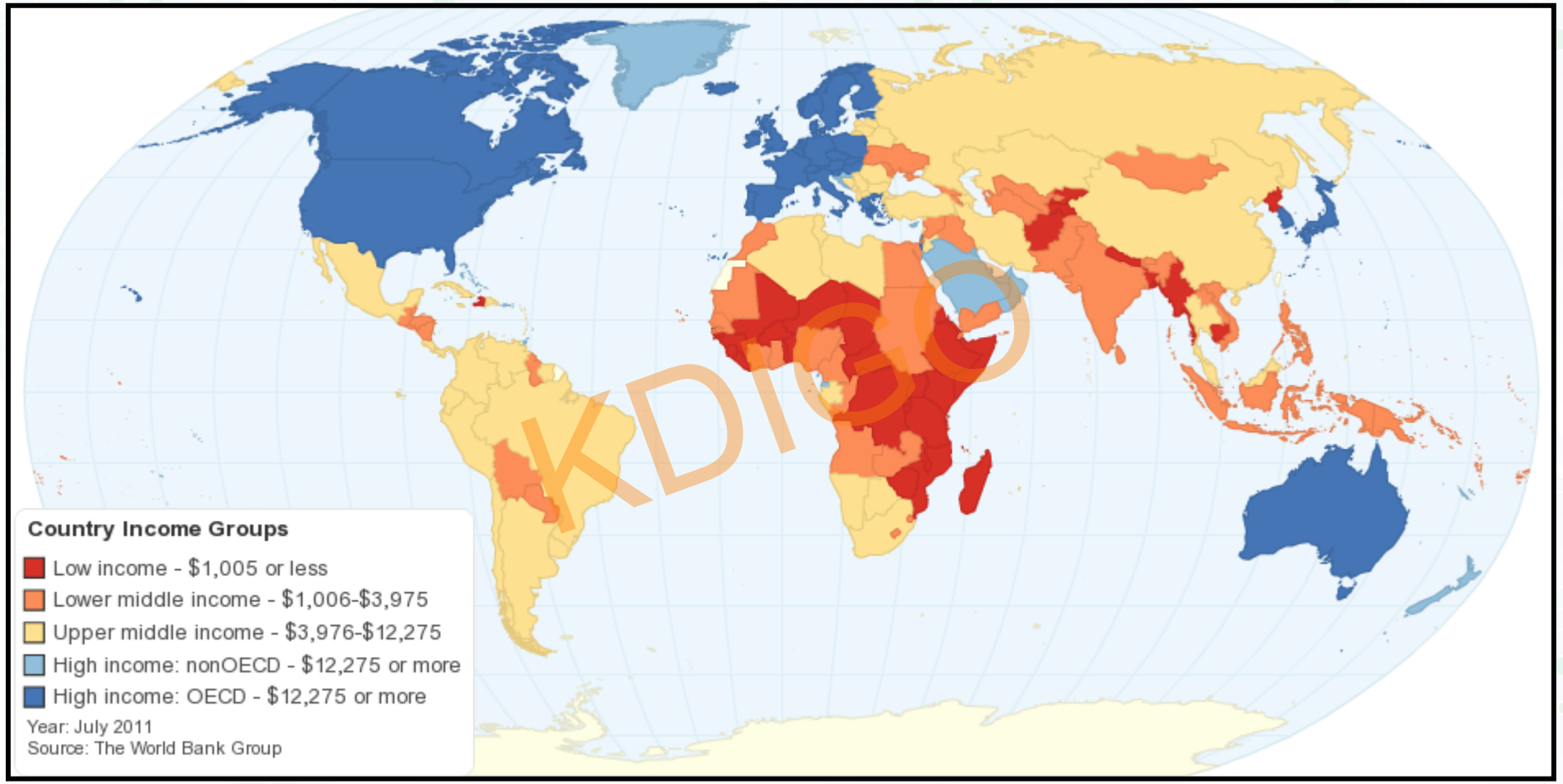
- Cerebrovascular: stroke/carotid
- Aortic stenosis
- Renovascular

OUTLINE

Central and Peripheral Arterial Diseases

- Global burden
- CKD as a risk factor
- Prognosis of CKD patients with arterial disease

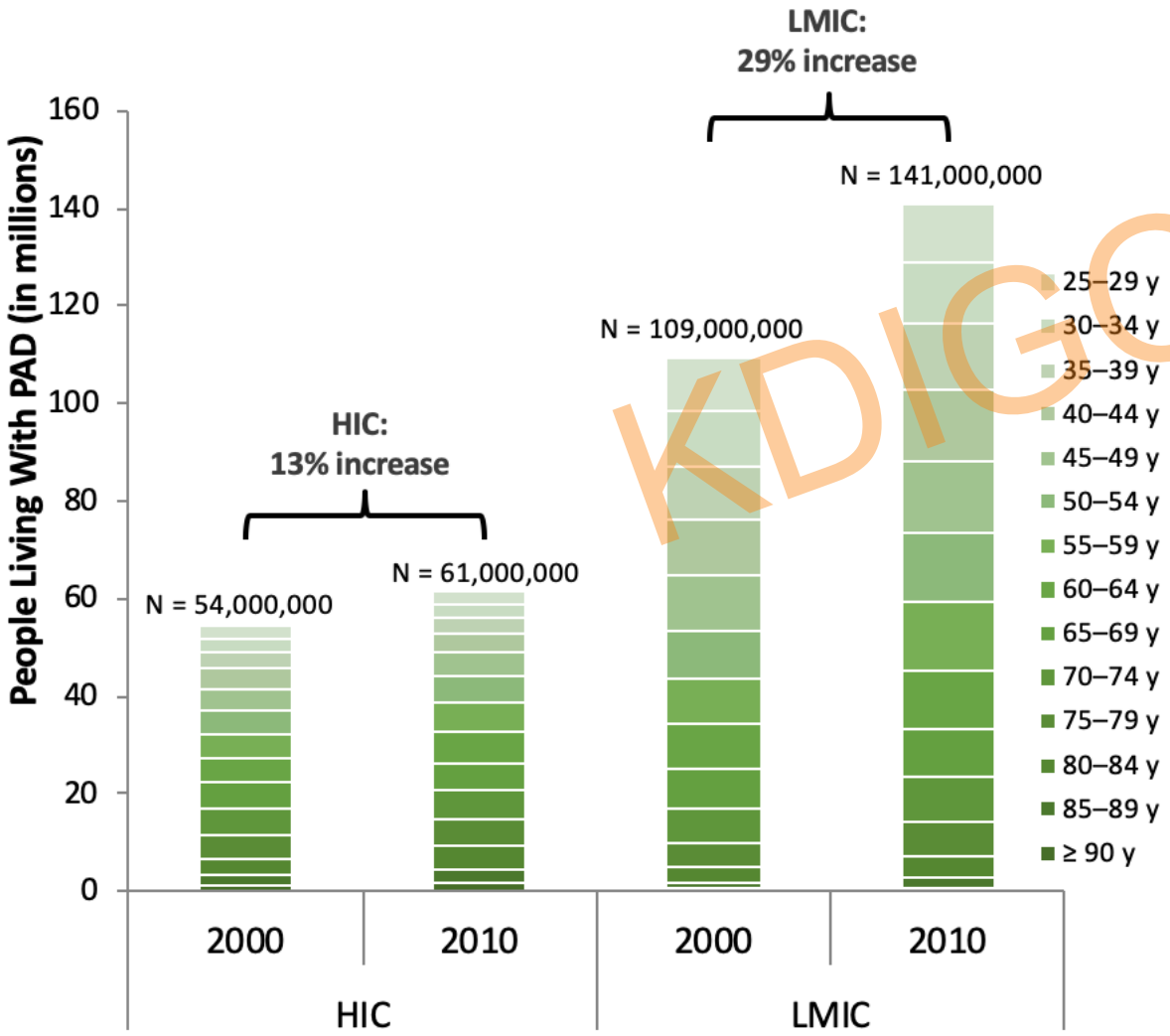
High and Low-Middle Income Regions



Country Income Groups (World Bank Classification), Country and Lending Groups, 2011, The World Bank Group, viewed 30th August, 2011.

Source: http://data.worldbank.org/about/country-classifications/country-and-lending-groups>.

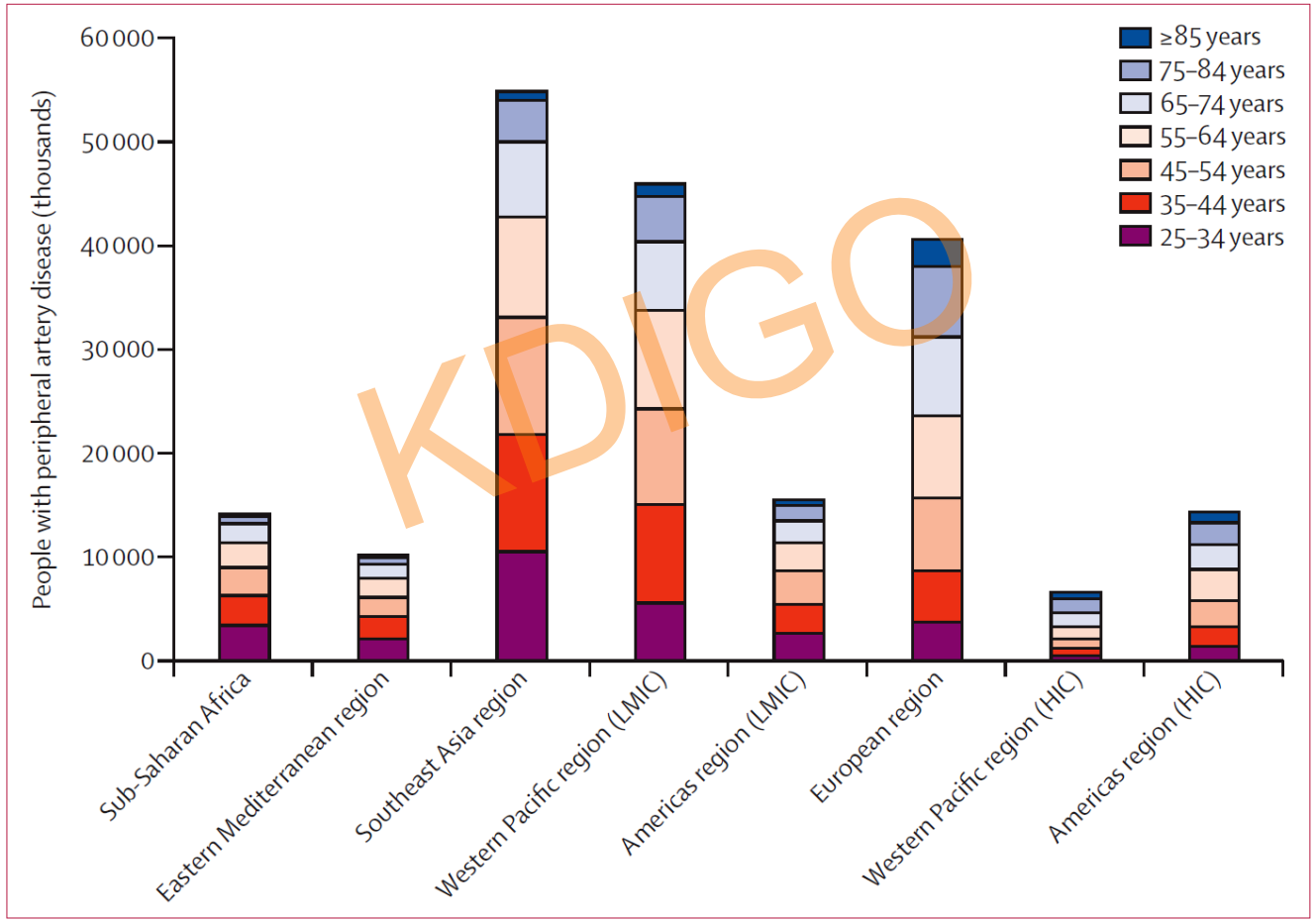
Trends In Peripheral Arterial Disease Numbers: 2000 to 2010



Due to global population ageing, estimated number of people with PAD increased by 24% between 2000 and 2010

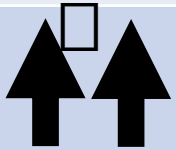
Fowkes et al. Lancet. 2013;382:1329-1340.

Numbers of Peripheral Arterial Disease Cases by World Region and Age



Fowkes FG et al. Lancet. 2013;382:1329-1340

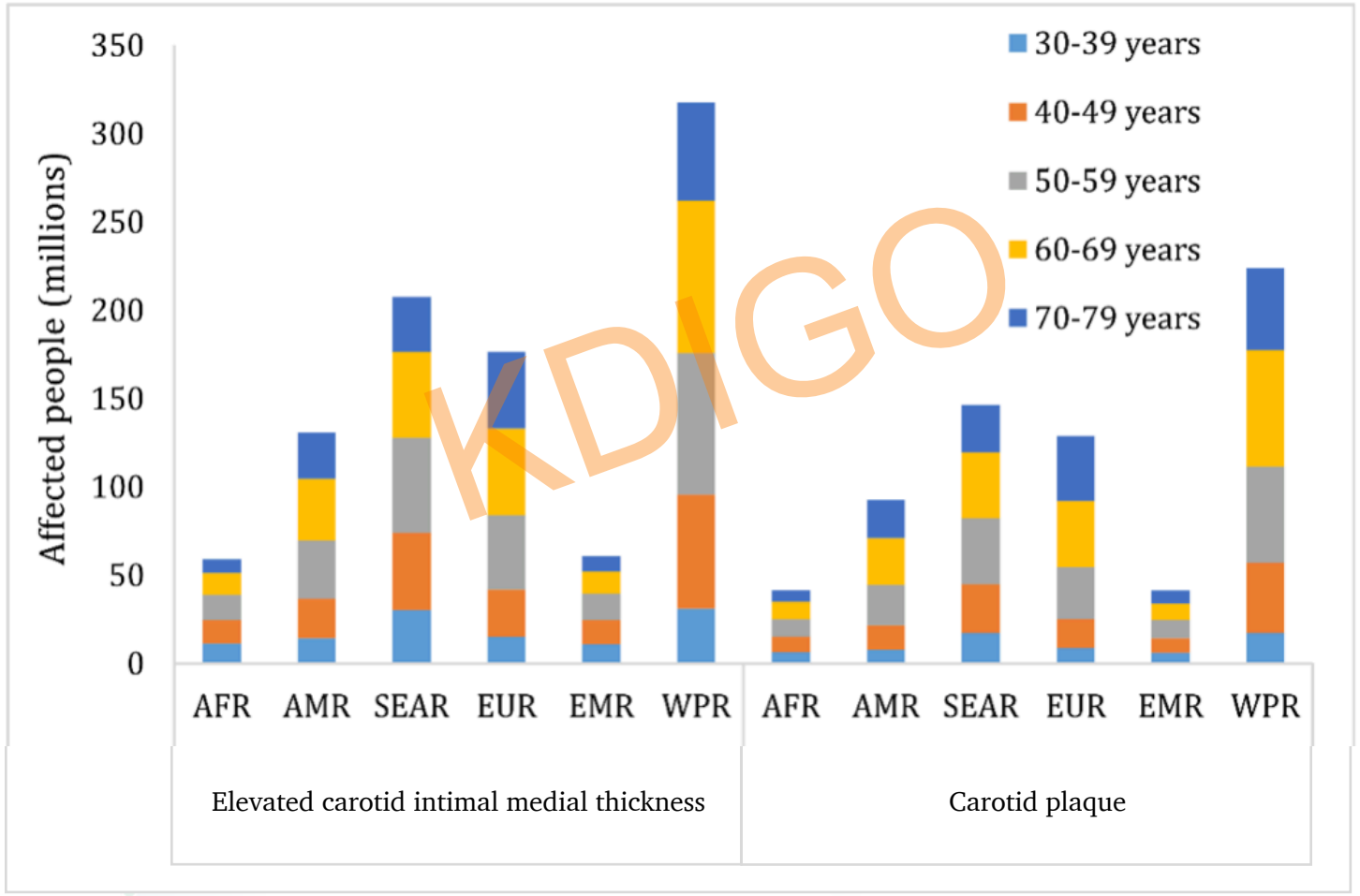
Numbers & Incidence of Stroke in high and low-middle income countries, 1990-2010.

HIC	1990	2010	Trend
Incidence (per 100,000)	246	217	
Numbers (millions)	4.2	5.3	
LMIC			
Incidence (per 100,000)	252	281	
Numbers (millions)	5.8	11.6	

Incidence : age standardized per 100,000 person years

Feigen V et al Lancet 2014; 383 : 245

NUMBERS WITH ELEVATED CAROTID INTIMAL MEDIAL THICKNESS AND CAROTID PLAQUE IN WORLD REGIONS BY AGE IN 2015

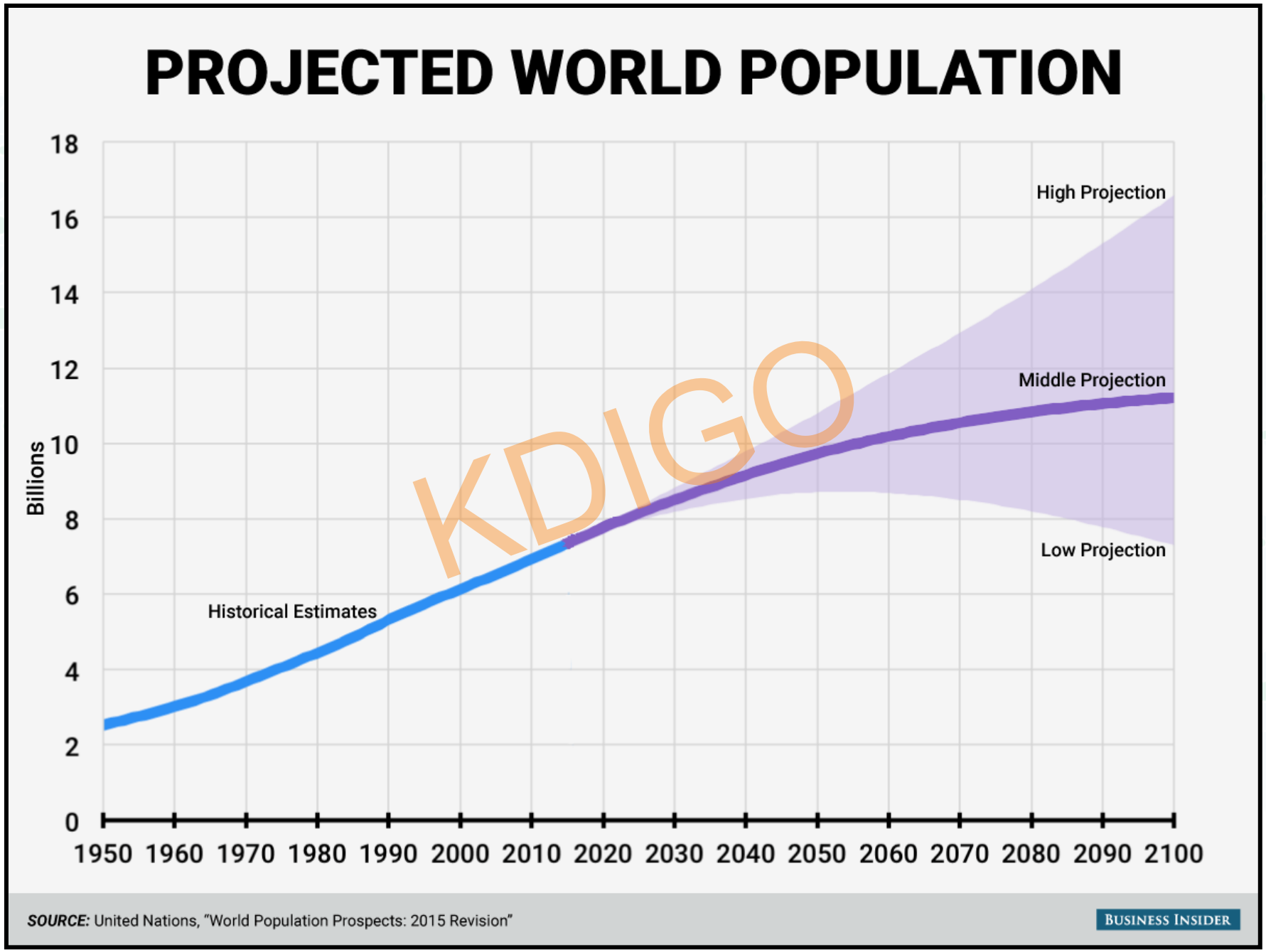


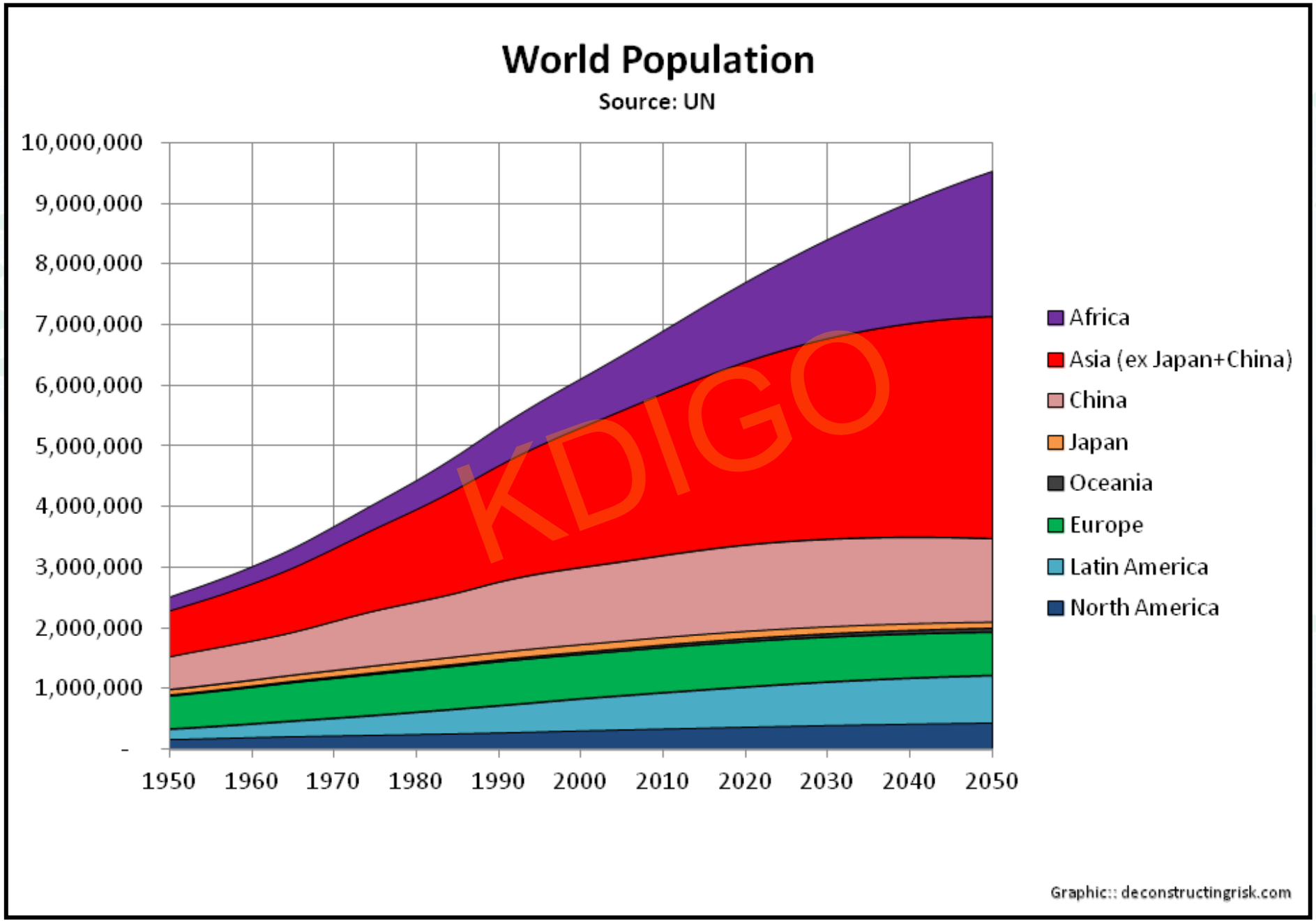
AFR= African Region; AMR= Region of the Americas; SEAR= South-East Asia Region; EUR= European Region; EMR= Eastern Mediterranean Region; WPR= Western Pacific Region

Song, et al. Submitted

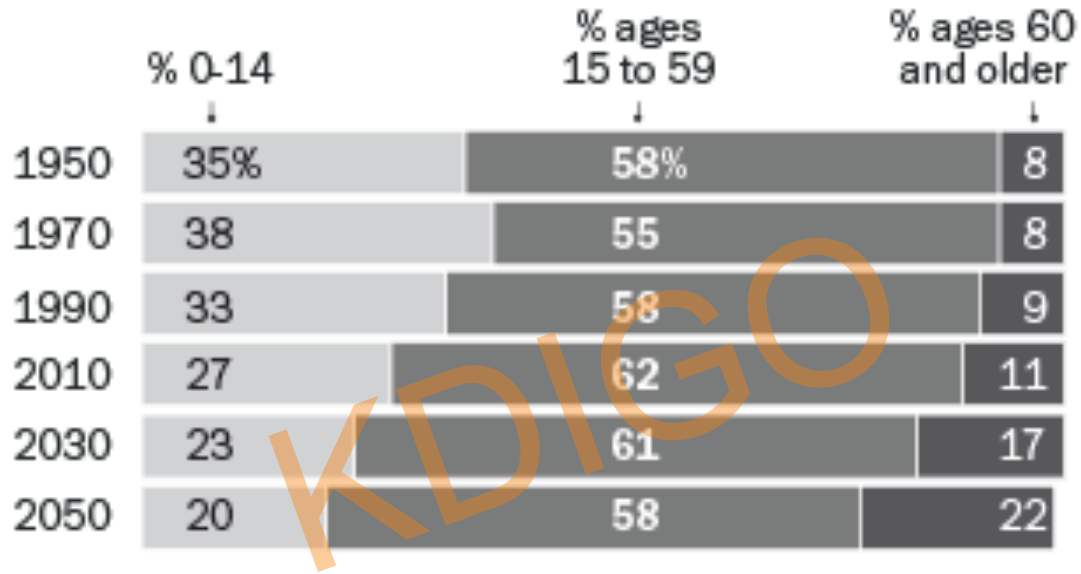
Global PAD Burden: Contributing Factors

- Ageing of the population
- Trends in cardiovascular risk factors
- Survival from myocardial infarction and stroke


PROJECTED WORLD POPULATION
Billions
18
16
14
12
10
8
6
4
2
0
1950 1960 1970 1980 1990 2000 2010 2020 2030 2040 2050 2060 2070 2080 2090 2100
High Projection
Middle Projection
Low Projection
Historical Estimates
KDIGO
SOURCE: United Nations, "World Population Prospects: 2015 Revision"
BUSINESS INSIDER


World Population
Source: UN
10,000,000
9,000,000
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
-
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
Africa
Asia (ex Japan+China)
China
Japan
Oceania
Europe
Latin America
North America
KDIGO
Graphic:: deconstructingrisk.com

Age Breakdown of World Population, 1950-2050



Sources: United Nations, World Population Prospects, the 2010 Revision; The Future of World Religions: Population Growth Projections, 2010-2050. Figures may not add to 100% due to rounding.

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Multivariate Risk Factor Associations with PAD in HIC vs LMIC

Risk factor	HIC: Odds Ratio for PAD (95%CI)	LMIC: Odds Ratio for PAD (95% CI)	P value HIC vs LMIC
Smoking current	2.7 (2.4-3.1)	1.4 (1.3-1.6)	<0.0001
Smoking former	2.0 (1.7-2.4)	1.5 (1.1-1.9)	0.04
Diabetes	1.9 (1.7-2.1)	1.5 (1.3-1.7)	0.009
Hypertension	1.6 (1.4-1.7)	1.4 (1.2-1.5)	0.06
High cholesterol	1.2 (1.1-1.3)	1.1 (1.0-1.3)	0.54
Cardiovascular disease	2.6 (2.2-3.0)	1.8 (1.4-2.2)	0.01

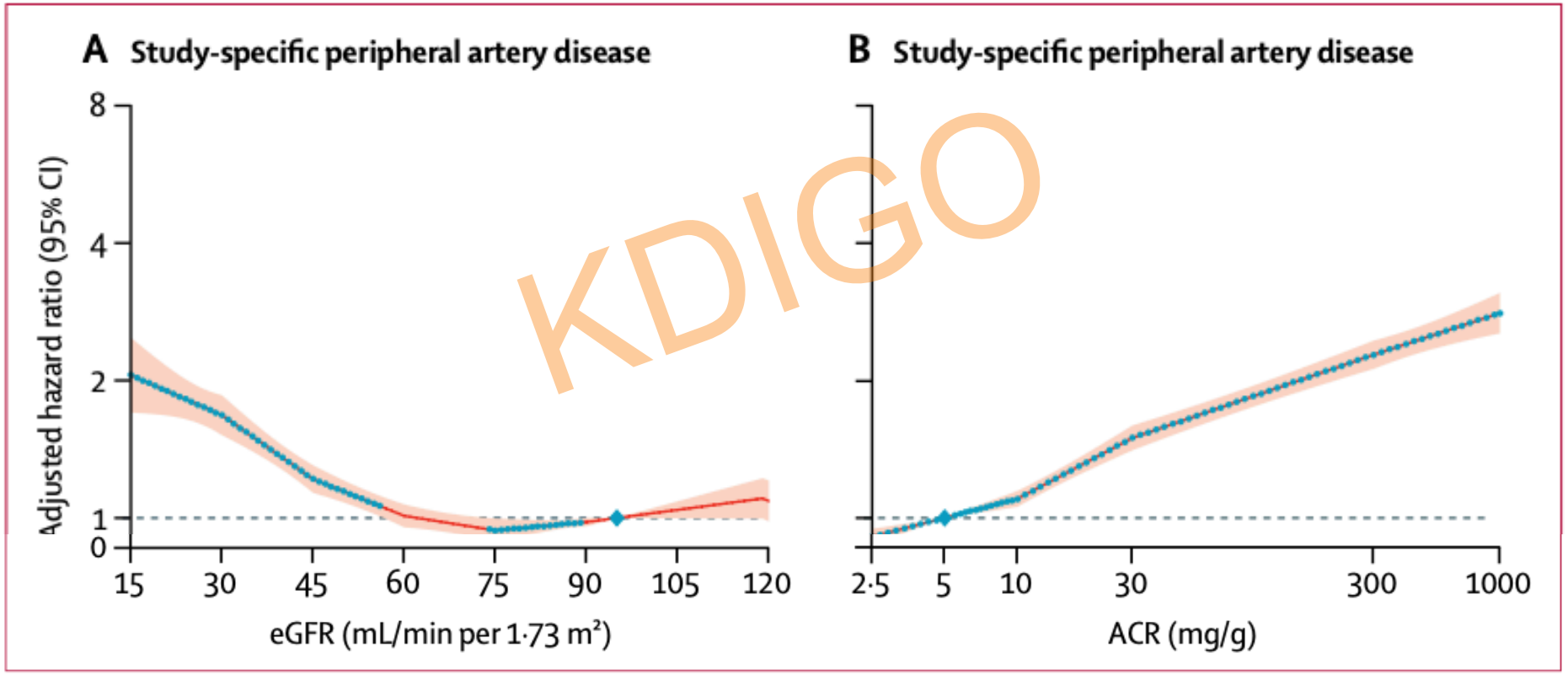
Top 10 countries for number of people with diabetes (20-79 years), 2013 and 2035

2013			2035	
Country	**Millions**		**Country**	**Millions**
China	98.4		China	142.7
India	65.1		India	109.0
United States of America	24.4		United States of America	29.7
Brazil	11.9		Brazil	19.2
Russian Federation	10.9		Mexico	15.7
Mexico	8.7		Indonesia	14.1
Indonesia	8.5		Egypt	13.1
Germany	7.6		Pakistan	12.8
Egypt	7.5		Turkey	11.8
Japan	7.2		Russian Federation	11.1
WORLD	382		WORLD	592

Guariguata et al. Diab Res Clin Pract 2014; 103: 137

Chronic Kidney Disease as a Risk Factor for Central and Peripheral Arterial Diseases

Relative Risk of Incident Peripheral Artery Disease by Baseline eGFR and Albumin Creatinine Ratio in 21 Cohorts in the CKD Prognosis Consortium



Matsushita et al. Lancet Diabetes Endocrind 2017; 15: 718

Meta-Analysis of Adjusted Relative Risks of all cause stroke by GFR and Albuminuria

CKD stage: GFR (ml/min/1.73m^2)	Studies (n)	Participants (n)	RR (95%CI)
Stage 1: ≥90<100 (versus>100)	1	91,432	1.04 (0.77 to 1.41)
Stage 2: ≥60<90 (versus≥90)	15	861,526	1.10 (1.03 to 1.19)
Stage 3: ≥30<60 (versus≥60)	52	2,100,733	1.43 (1.33 to 1.54)
Stage 4/5: <30 (versus≥30)	15	1,743,690	1.70 (1.47 to 1.96)
Albuminuria			
Micro (versus none)	24	1,124,229	1.53 (1.40 to 1.67)
Macro (versus none)	24	1,249,907	1.94 (1.64 to 2.29)

Masson et al. Nephrol Dial Transplant 2015; 30: 1162

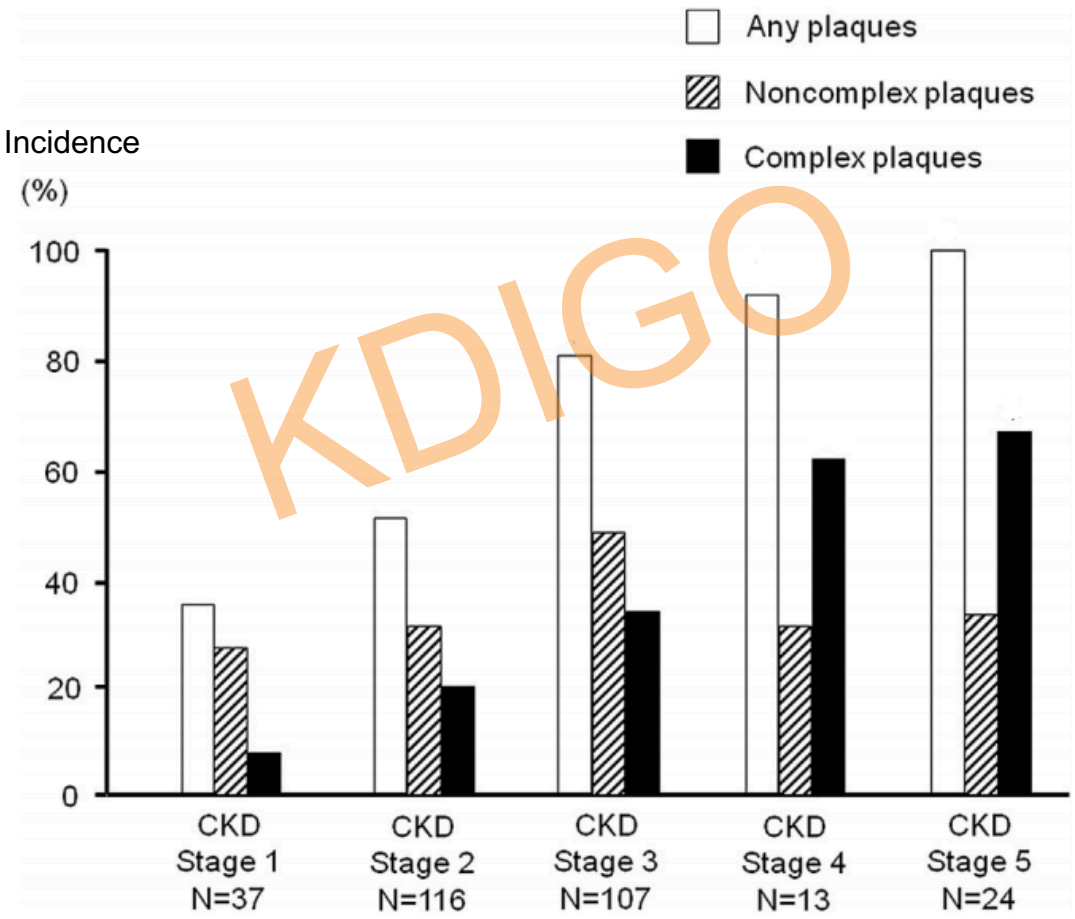
Carotid Atherosclerosis: Multivariate Adjusted Mean Intimal Medical Thickness and Risk of Stenosis by eGFR in Suita Study

eGFR ml/min per 1.73m²	≥ 90	60-89	50-59	< 50
Mean max IMT				
Men	1.43	1.48	1.51	1.63*
Women	1.21	1.20	1.21	1.34*
OR for stenosis				
Men	1	1.56	1.85	1.81
Women	1	0.84	0.91	2.04

*p < 0.05

Ohara et al Stroke 2013; 44: 3537

"Incidence" of Atherosclerotic Plaques in Thoracic Aorta by Severity of Renal Dysfunction



Matsumura et al. Atherosclerosis 2014; 237: 301

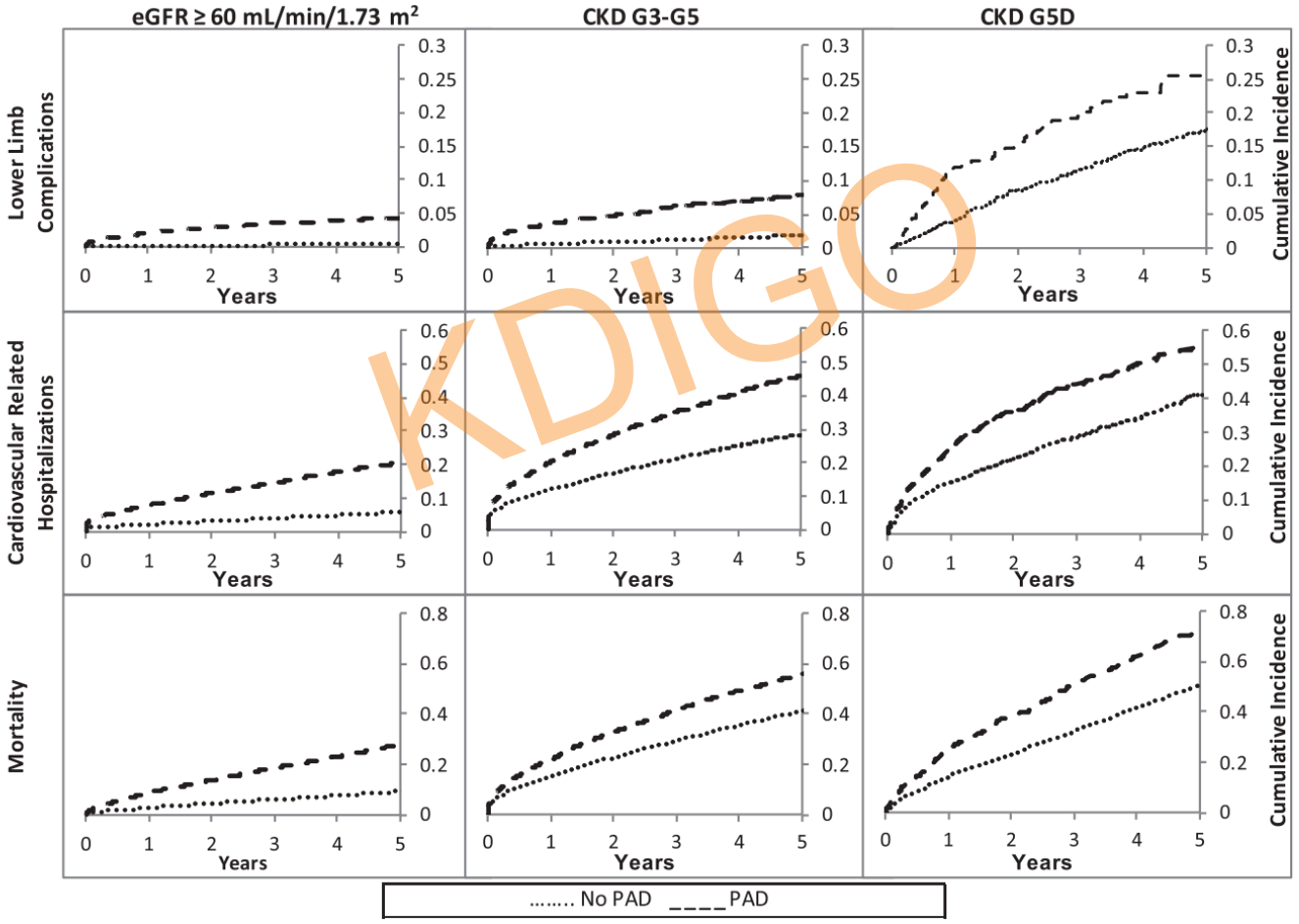
Disability Adjusted Life Years (DALYS) Due to Stroke for Selected Risk Factors by Country Income Level, 2013

Risk Factor	DALYS (%) attributable to risk factor	
	Low and middle income countries	High income countries
High systolic BP	65.1	59.8
Poor diet	65.3	55.1
Air pollution	33.7	10.2
Smoking	23.6	19.6
Low GFR	6.5	9.5

Feigin et al. Lancet Neurology 2016; 15: 913

Prognosis of Chronic kidney disease patients with Arterial Disease

Cumulative Incidence of Lower-Limb Complications, Cardiovascular-Related Hospitalizations, and Mortality by Kidney Function with and without Peripheral Artery Disease (PAD)



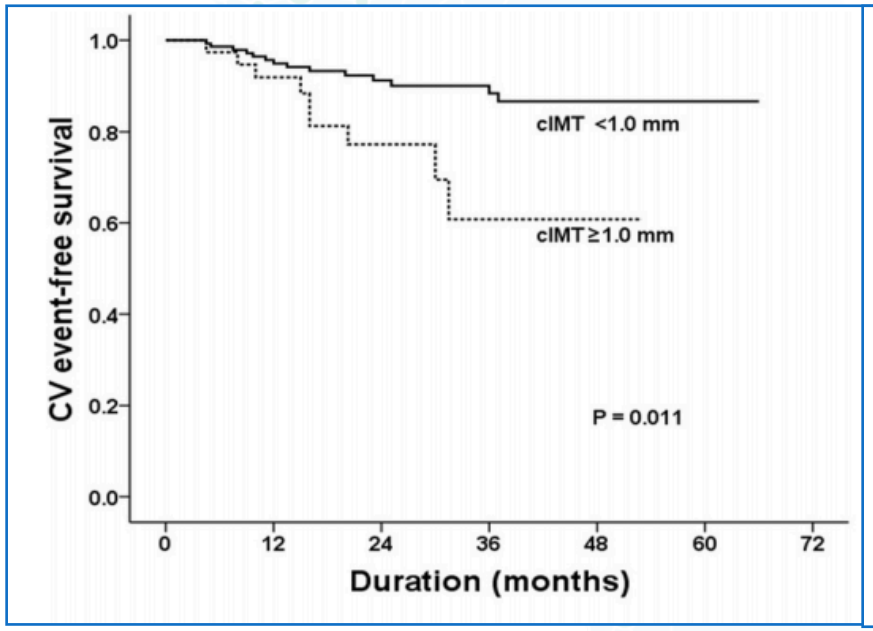
Bourrier et al. Am J Kidney Dis 2019 (in press)

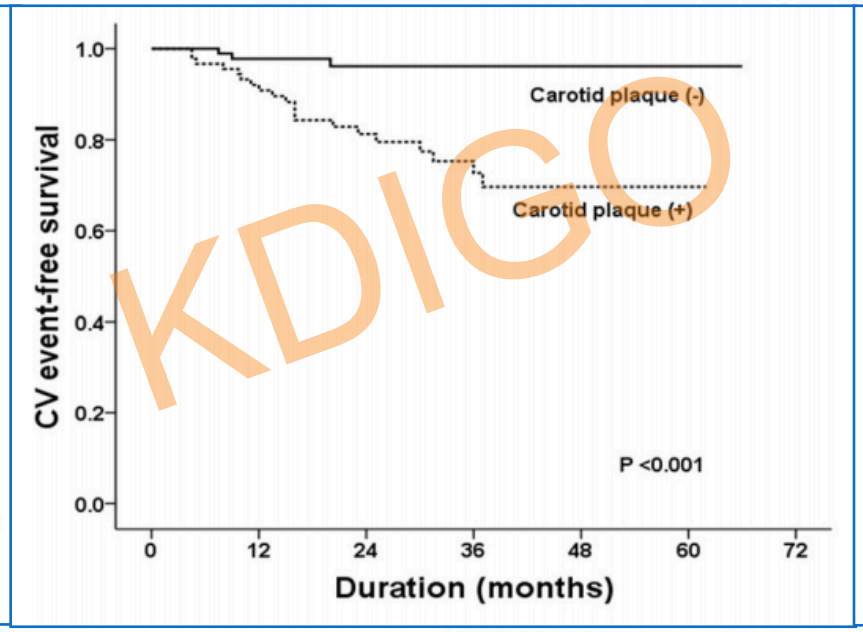
Cumulative Mortality and Cardiovascular Events after Acute Stroke According to eGFR

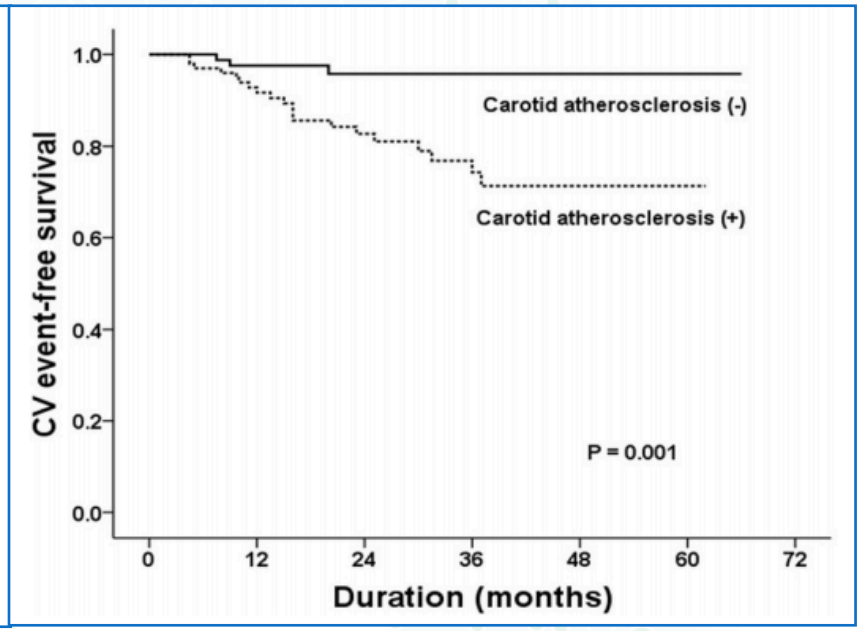
	Cumulative %			
Mortality	**GFR > 60**	**30 ≤ GFR ≤ 60**	**GFR < 30**	**P-value**
1 month	10.5	17.6	21.4	0.003
1 year	20.6	33.6	54.5	0.001
10 year	62.8	77.3	89.2	0.001
CV events				
1 month	3.8	6.6	9.1	0.098
1 year	13.3	17.8	36.0	0.021
10 year	45.2	67.4	77.6	0.001

Tsagalis et al. Nephrol Dial Transplant 2009; 24: 194

Cardiovascular Event-Free Survival According to Presence or Absence of Indications of Carotid Artery Disease in Non-Diabetic Patients with CKD

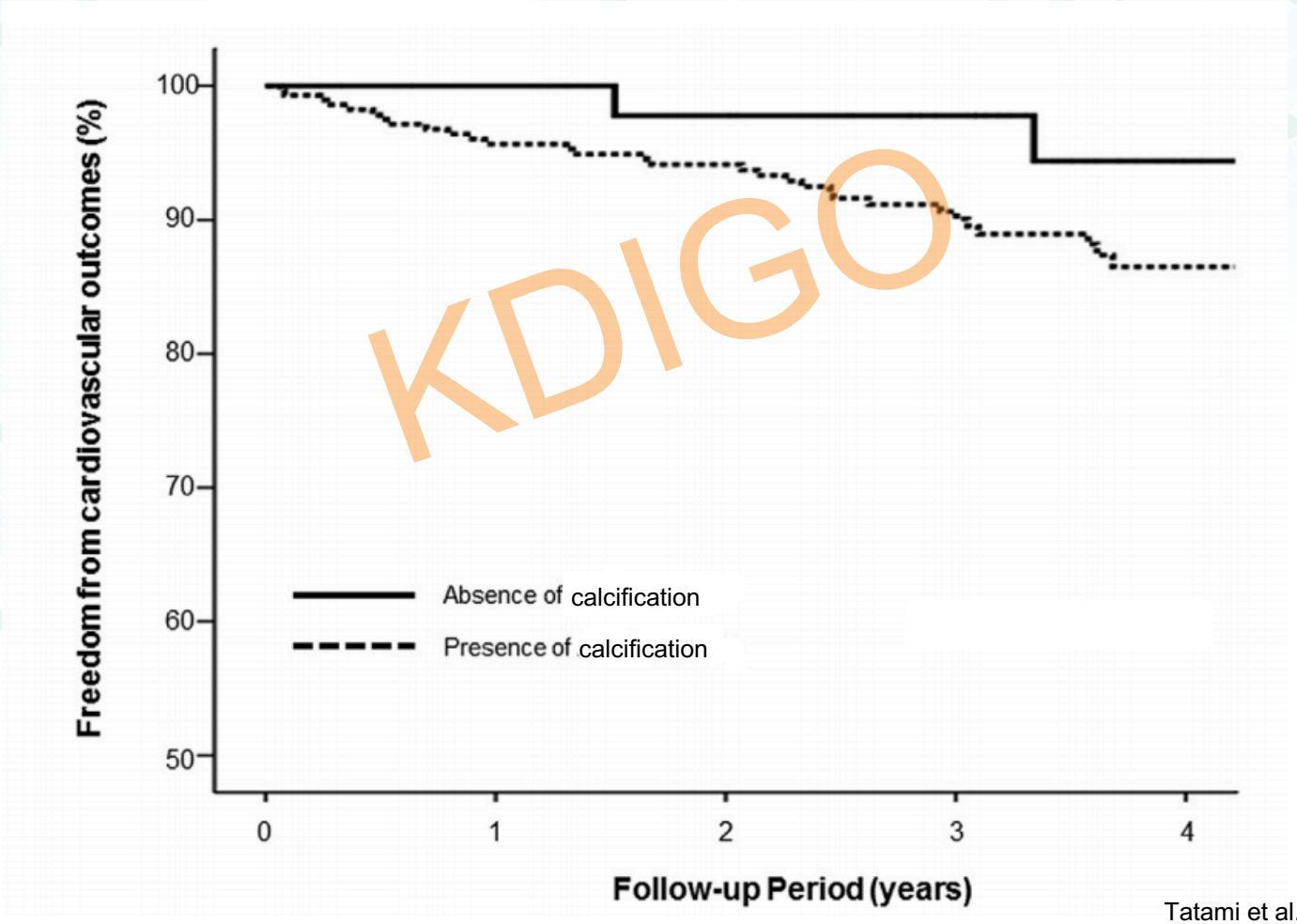






Kim et al. BMC Cardiovasc Dis 2013; 13: 96

Cardiovascular Event-Free Survival Curves for Asymptomatic CKD Patients According to Presence or Absence of Abdominal Aortic Calcification



Tatami et al. Atherosclerosis 2015; 245: 349

Annual Incidence (%) of New Cardiovascular Events in US Medicare Population with and without Renovascular Disease

	Incidence of events %	
	No renovascular disease	**Renovascular disease**
Coronary artery disease	7.4	30.4
Congestive cardiac failure	5.6	19.5
Stroke/TIA	5.3	17.6
Peripheral artery disease	5.2	25.9
Death	6.3	16.6

Chrysochou + Kalra Prog Cardiov Dis 2009; 52: 184

General Conclusions

- Global burden of central and peripheral arterial diseases increasing rapidly especially in low- and middle-income countries

- Chronic kidney disease is an independent risk factor for arterial disease and likely to contribute to the global burden

- Chronic kidney disease patients with arterial disease have worse prognosis than those without arterial disease