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Plasma Glucose Regulation and Mortality in Korea: A Pooled Analysis of Three Community-Based Cohort Studies

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The Committee on the Epidemiology of Diabetes, KDA

- Prof. Yong Soo Park (chairman) and 22 committee members
- Three population based cohort studies (Yonchon, Jungeup, and Ansan studies) were selected and linked with death certificate data from Korean National Statistical Office.
- Impact of diabetes and glucose tolerance categories on all cause and cause-specific mortality in **pooled analysis of community-based cohort studies** was analyzed

Pooled Analysis of Three Community-based Cohort Studies on Diabetes

Selection criteria

- Study since 1990
- Community-based
- Minimum requirement
 - Age, sex, body weight, height, waist and hip circumference, systolic and diastolic pressure
 - Fasting plasma and 75 g 2 hr post load glucose
 - Total cholesterol, HDL cholesterol, triglyceride
 - Previous medical history of diabetes
 - smoking
 - Residence ID number



- ### Yonchon cohort
- 1993
 - 2304 persons
 - age: 30-64 years
 - 16 years F/U

- ### Ansan cohort
- 2000
 - 1730 persons
 - age: 18-84 years
 - 9 years F/U

- ### Chongup cohort
- 1997
 - 1105 persons
 - age: 40-99 years
 - 12 years F/U

Baseline characteristics

Characteristic	Yonchon (<i>n</i> =1,340)	Chongup (<i>n</i> =1,105)	Ansan (<i>n</i> =1,356)	<i>P</i> value
Male sex	608 (45.37)	422 (38.19)	553 (40.78)	0.0012
Age, yr	50.29±12.68	59.02±9.95	45.01±13.77	<0.0001
BMI, kg/m ²	24.06±3.31	23.77±3.08	23.44±3.19	<0.0001
WHR	0.87±0.09	0.88±0.06	0.87±0.08	0.0013
FPG, mmol/L	5.83±1.27	5.34±1.72	5.79±1.33	<0.0001
PPG, mmol/L	6.54±3.01	7.14±3.2	6.95±3.13	<0.0001
SBP, mm Hg	125.51±21.29	142.82±23.07	119.41±18.13	<0.0001
DBP, mm Hg	81.51±13.81	85.36±11.93	75.76±13.61	<0.0001
TC, mmol/L	4.08±0.83	5.24±0.94	5.03±0.99	<0.0001
Triglyceride, mmol/L	1.41 (0.97–3.07)	1.62 (1.16–2.35)	1.27 (0.88–1.82)	<0.0001
HDL-C, mmol/L	0.96±0.31	1.18±0.29	1.19±0.35	<0.0001
Current smoker	181 (13.51)	322 (29.14)	303 (22.35)	<0.0001

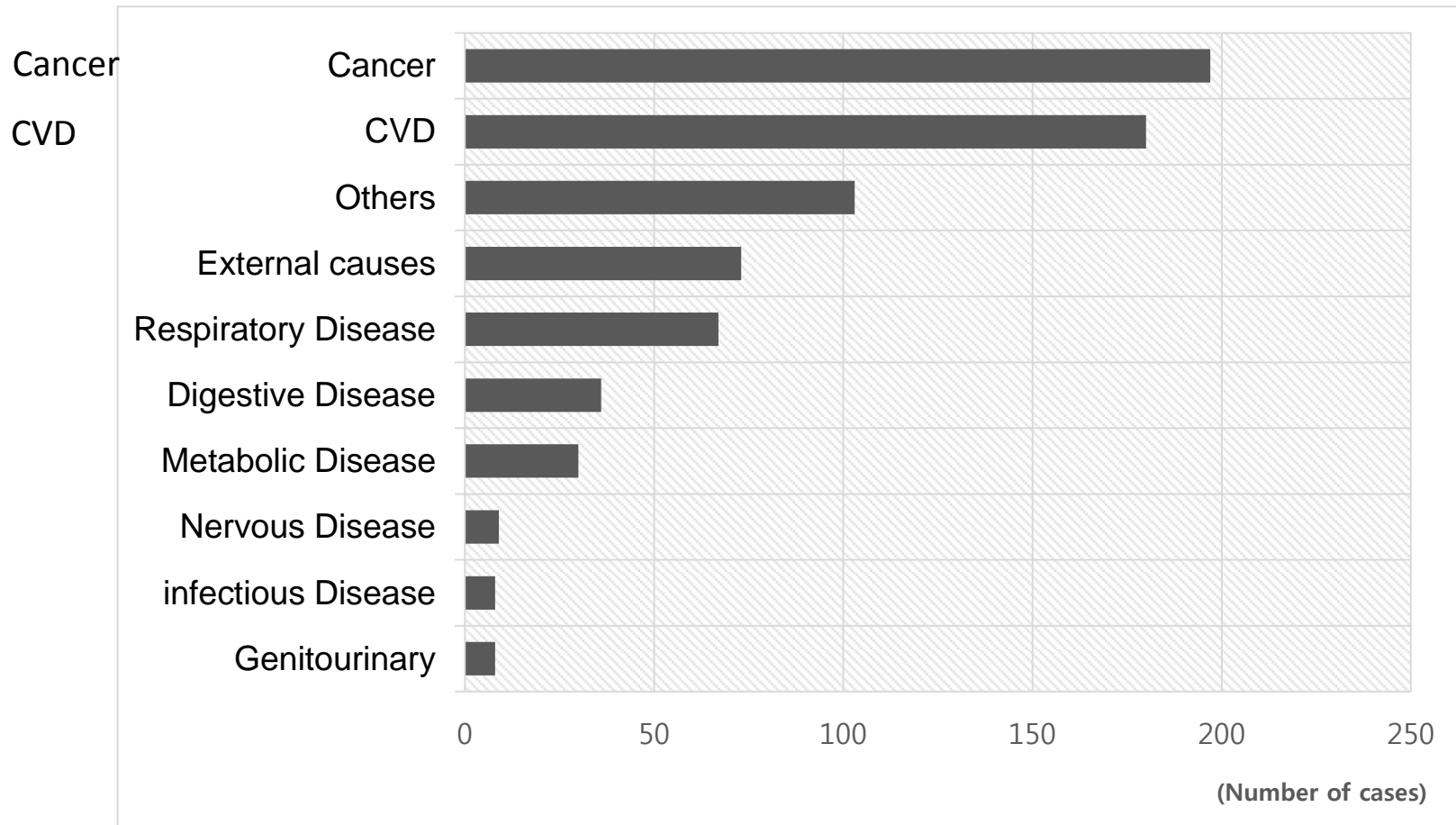
Values are presented as number (%), mean ± standard deviation, or median (1st quartile–3rd quartile).

BMI, body mass index; WHR, waist-hip ratio; FPG, fasting plasma glucose; PPG, 2-hour glucose after 75 g glucose loading; SBP, systolic blood pressure; DBP, diastolic blood pressure; TC, total cholesterol; HDL-C, high density lipoprotein cholesterol.

Plasma glucose regulation and mortality in Korea

: A pooled analysis of three community-based cohort studies

Median f/u: 15.7 yr, N. of all-cause death: 711

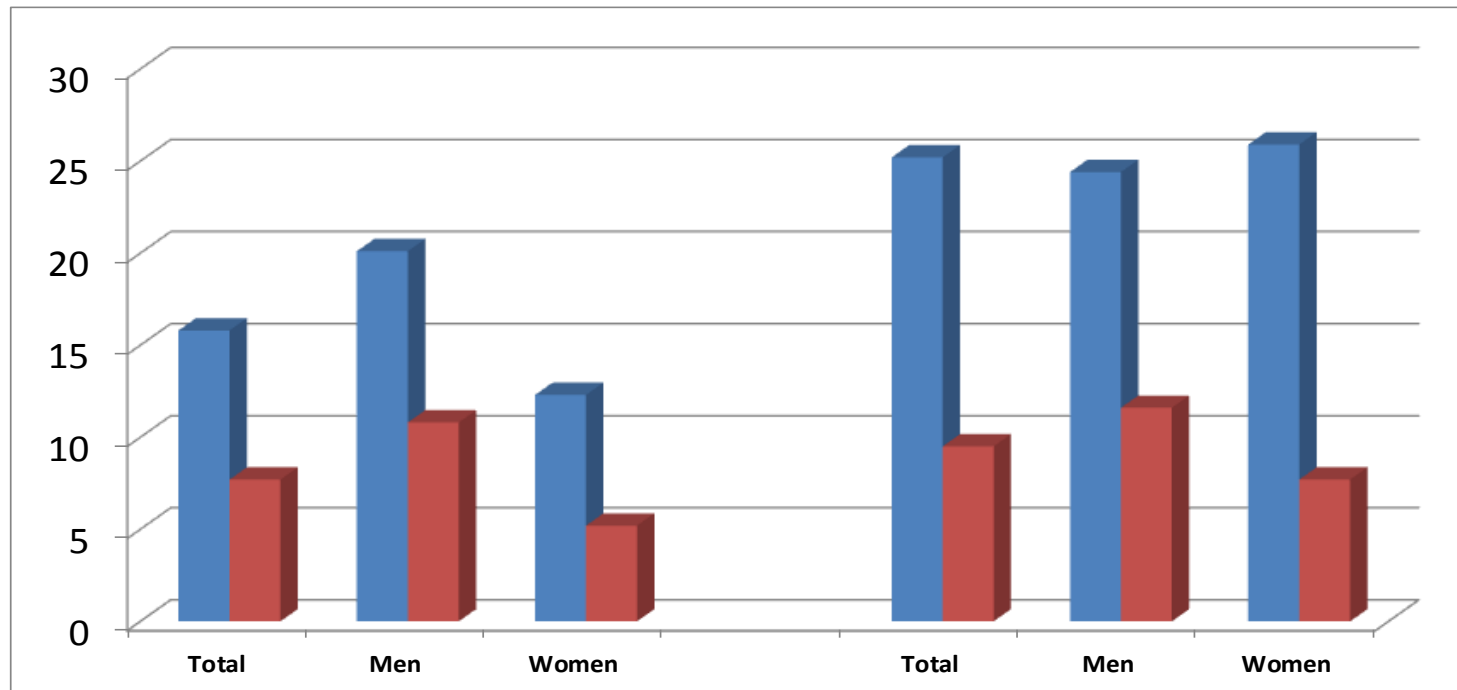


Impact of diabetes on all-cause mortality



All-cause mortality rate in another cohorts (DM vs. non-DM)

(/1000 person-years)



Framingham Cohort (1976-2001)¹

NHANES III (1988-2000)²

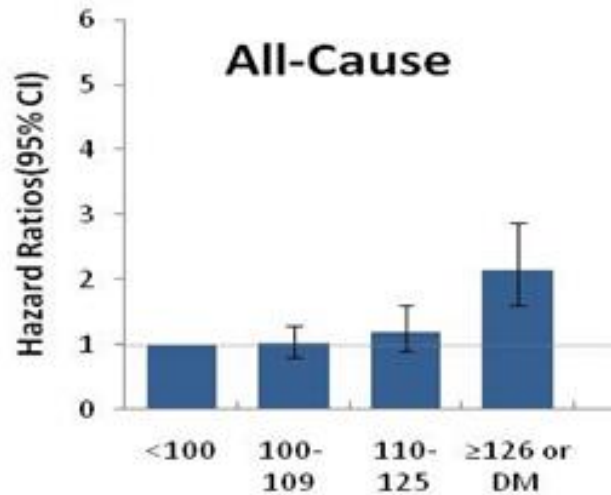
¹Ann Intern Med 2007;147:149-155

²Circulation 2009;119:1728-1735

Plasma glucose regulation and mortality in Korea

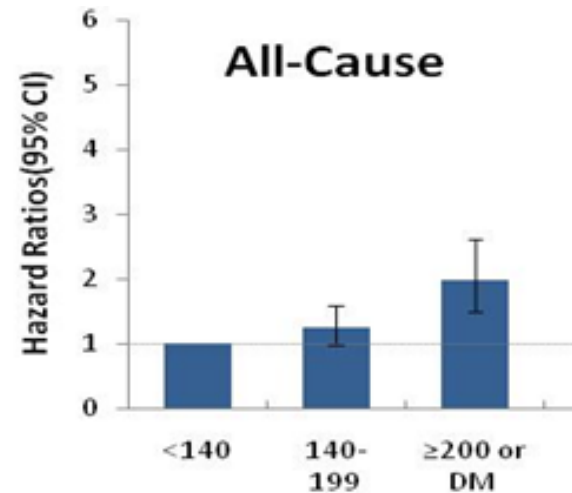
: A pooled analysis of three community-based cohort studies

a) FPG



FPG(mg/dL) regardless of 2hPG

b) 2hPG



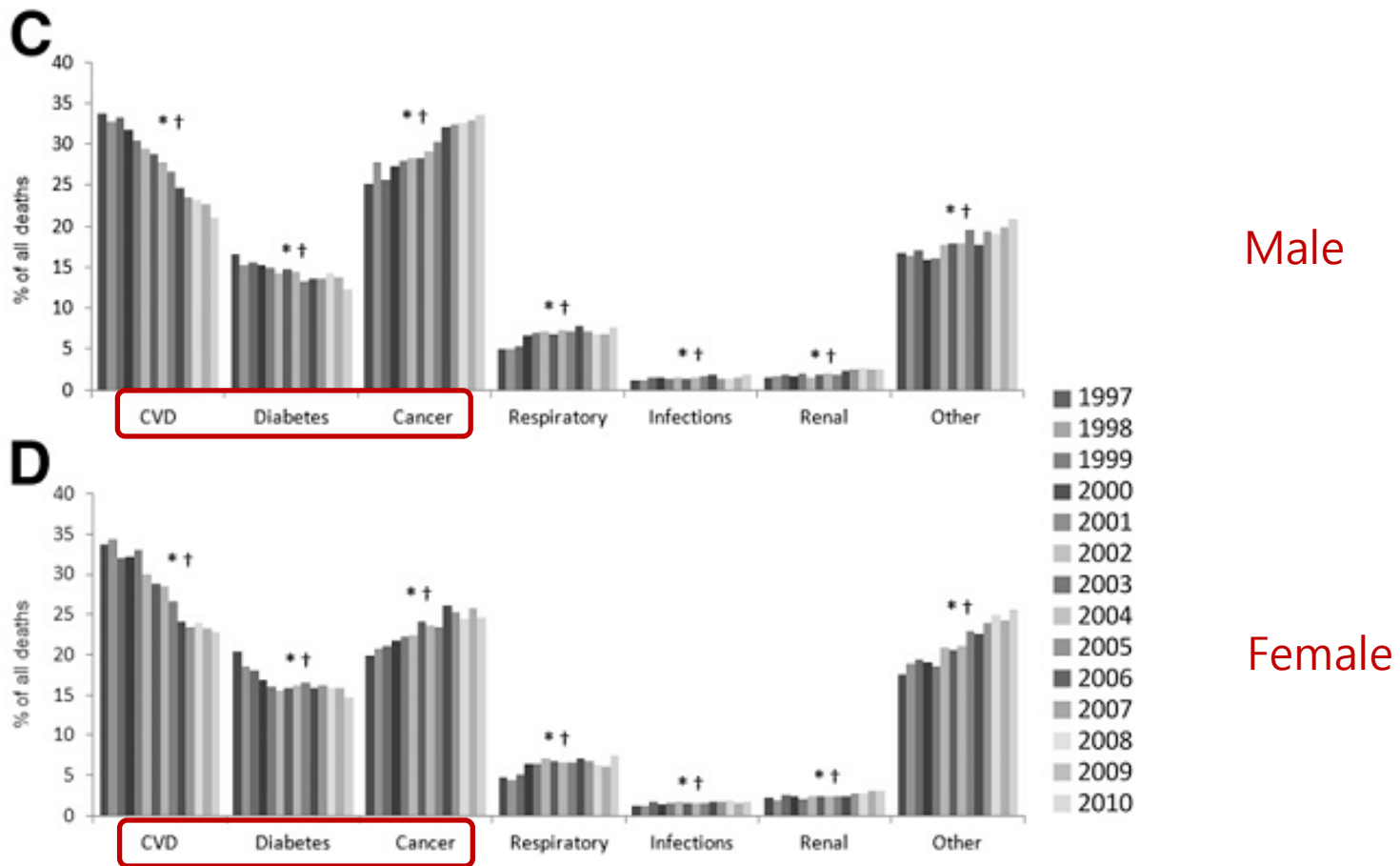
2hrPG(mg/dL) regardless of FPG

HR: Adjusted for age, sex, study center, BMI, systolic blood pressure, total cholesterol, HDL-cholesterol and smoking status.

**What is the main cause of death
in subjects with diabetes?**

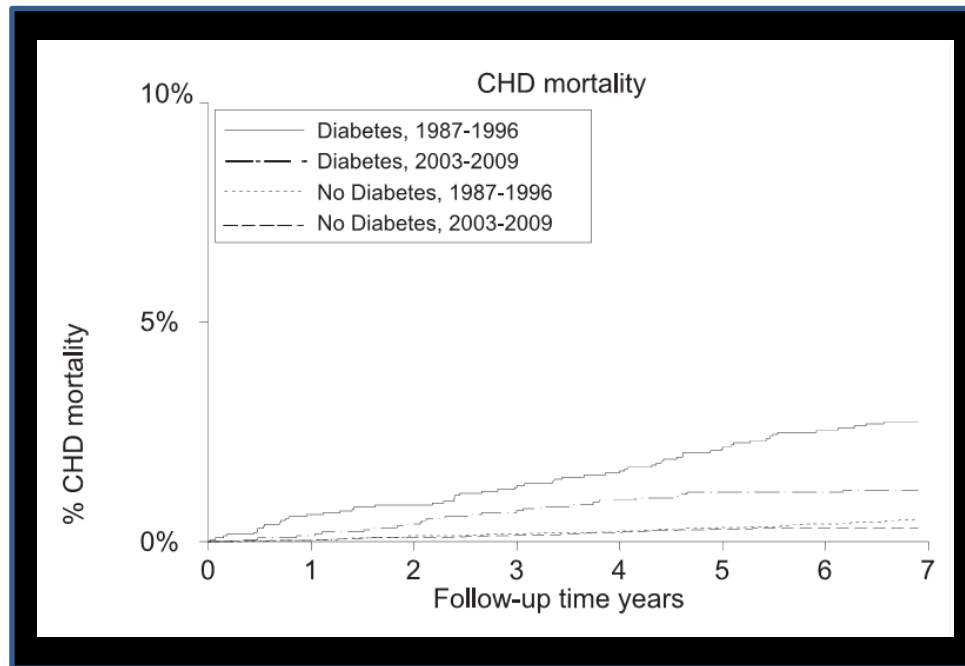


Mortality trends among people with type 2 diabetes in Australia: 1997-2010



Declines in coronary heart disease mortality in middle aged adults

Two epidemiologic studies analyzed the data in 1987-1996 and 2003-2009 in the US

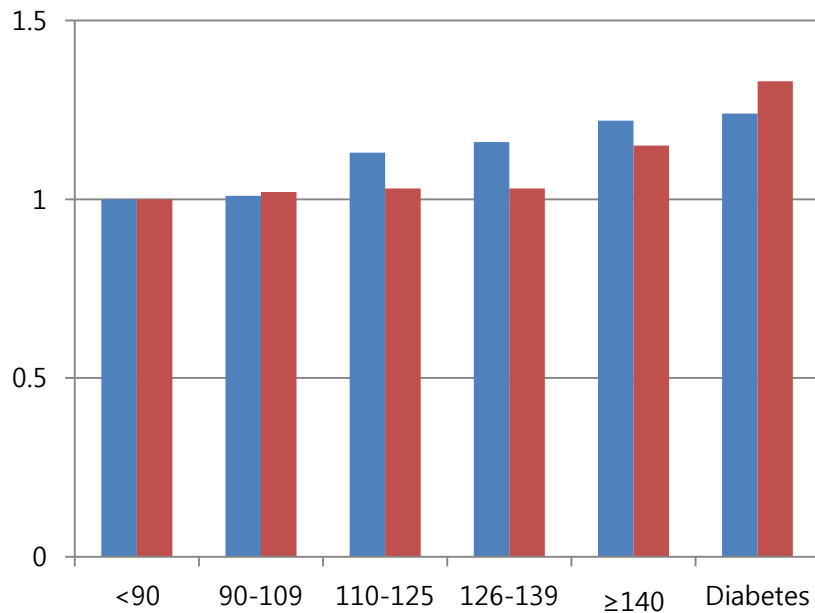


DM, 1987-1996
DM, 2003-2009
Non-DM

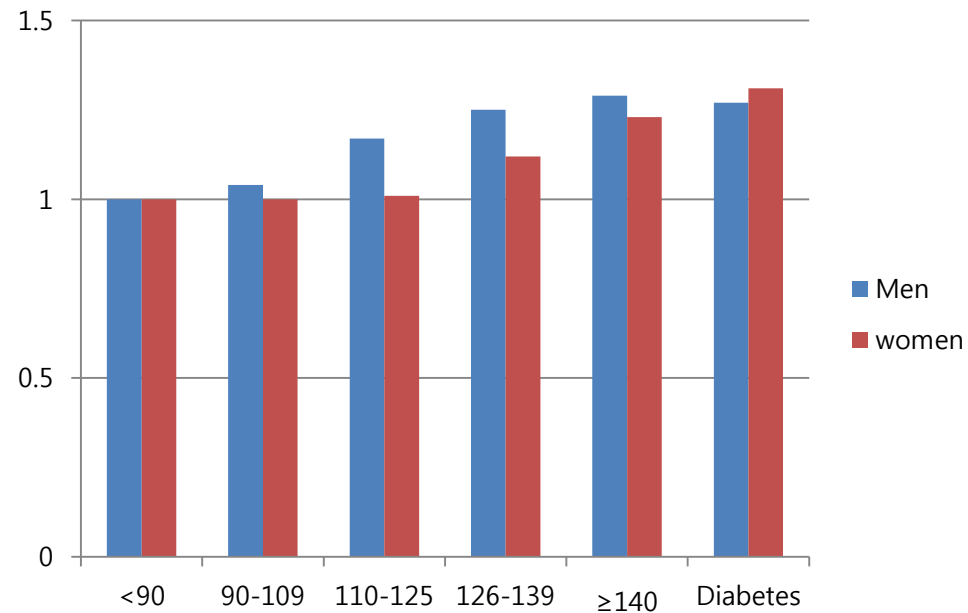
Fasting Serum Glucose Level and Cancer Risk in Korean Men and Women

10yr prospective cohort study of more than one million Koreans who received Health insurance from the National Health Insurance Corp.

Cancer incidence by FPG levels



Cancer mortality by FPG levels

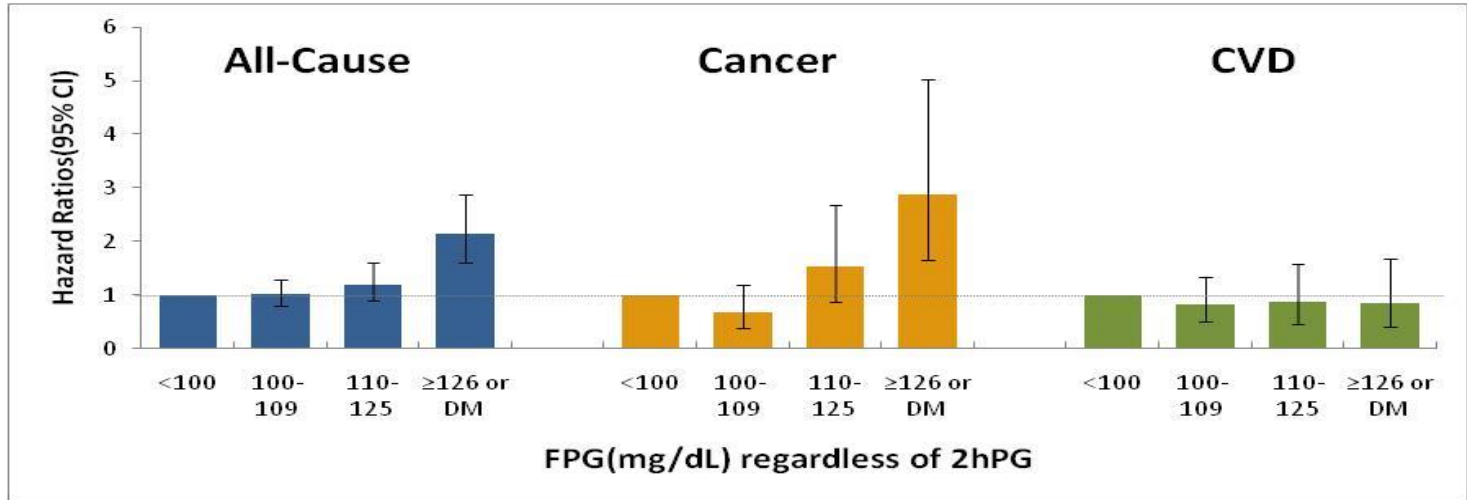


Diabetes: FPG ≥126 or medication

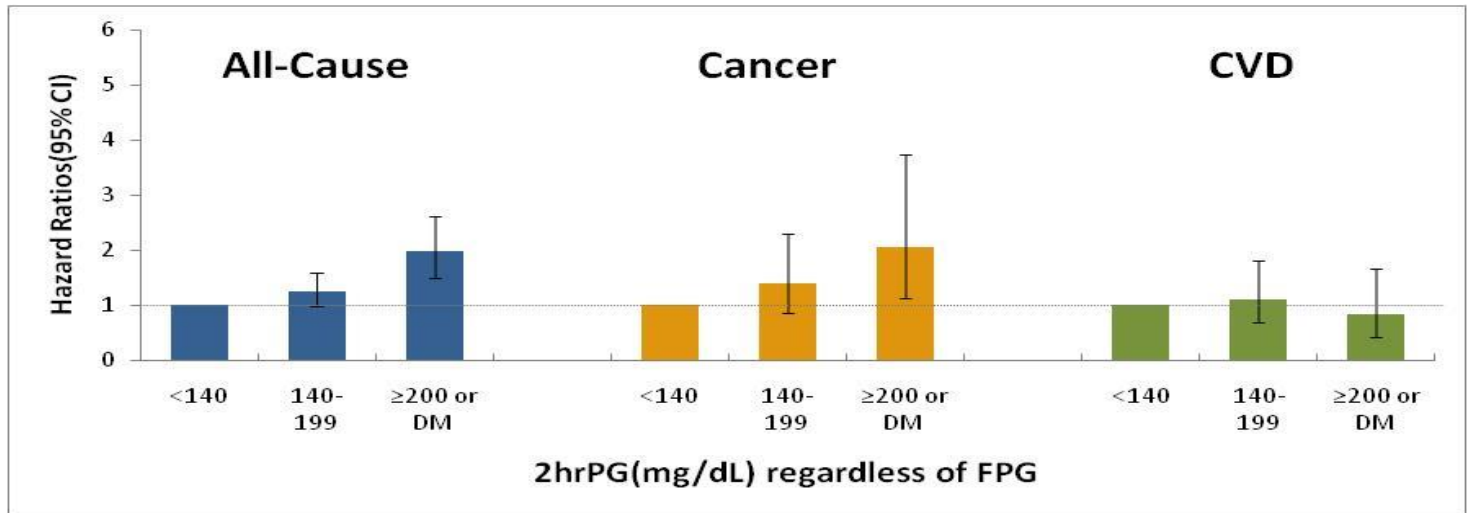
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a) FPG



b) 2hPG



HR: Adjusted for age, sex, study center, BMI, systolic blood pressure, total cholesterol, HDL-cholesterol and smoking status.

The possible cause of the null association of diabetes and CVD death

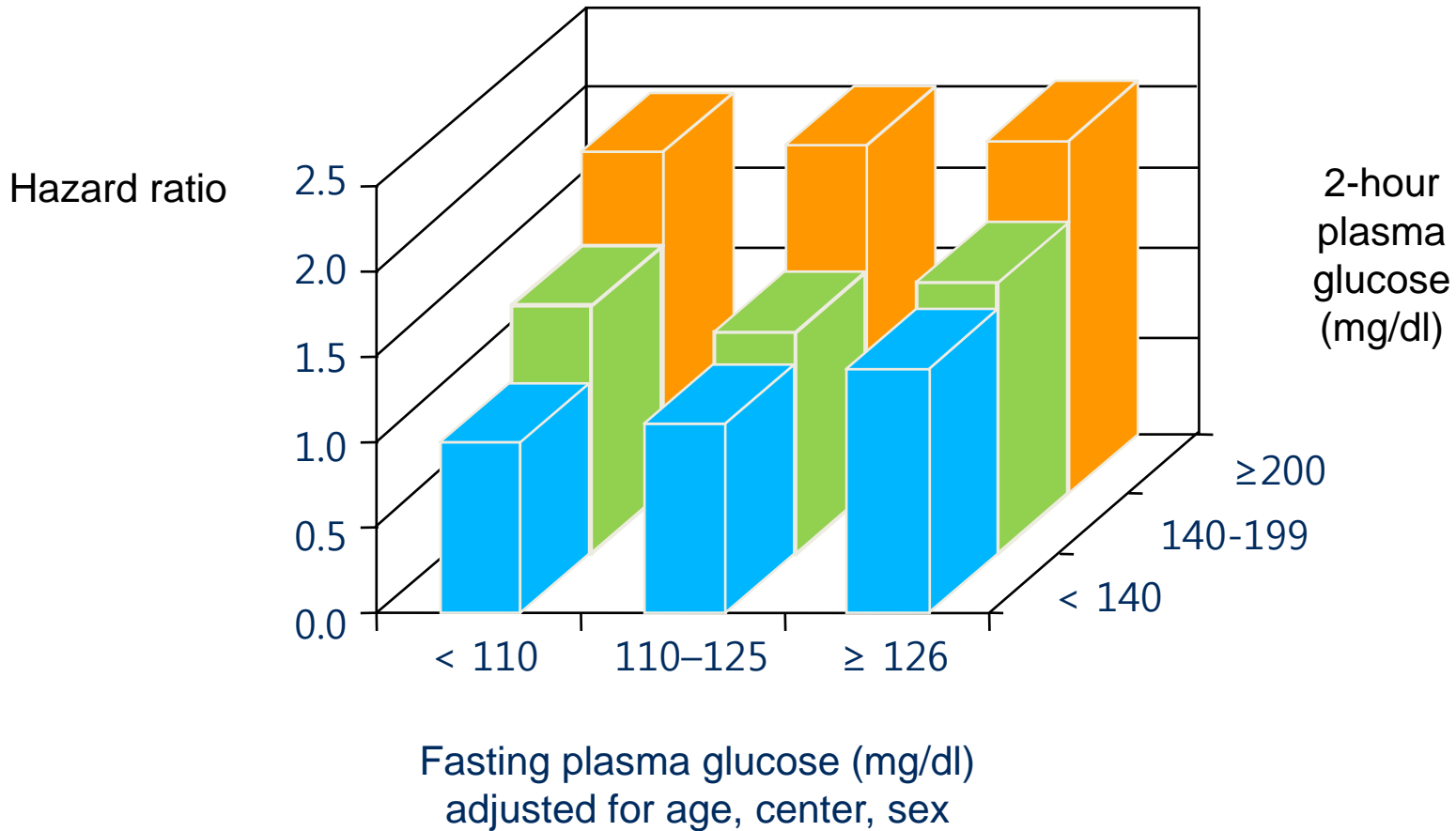
- Short duration of diabetes
- Limited number of CVD deaths (N=180)
- Inaccuracies in the cause of death for CVD in death certificate

Is prediabetes a risk factor for death?



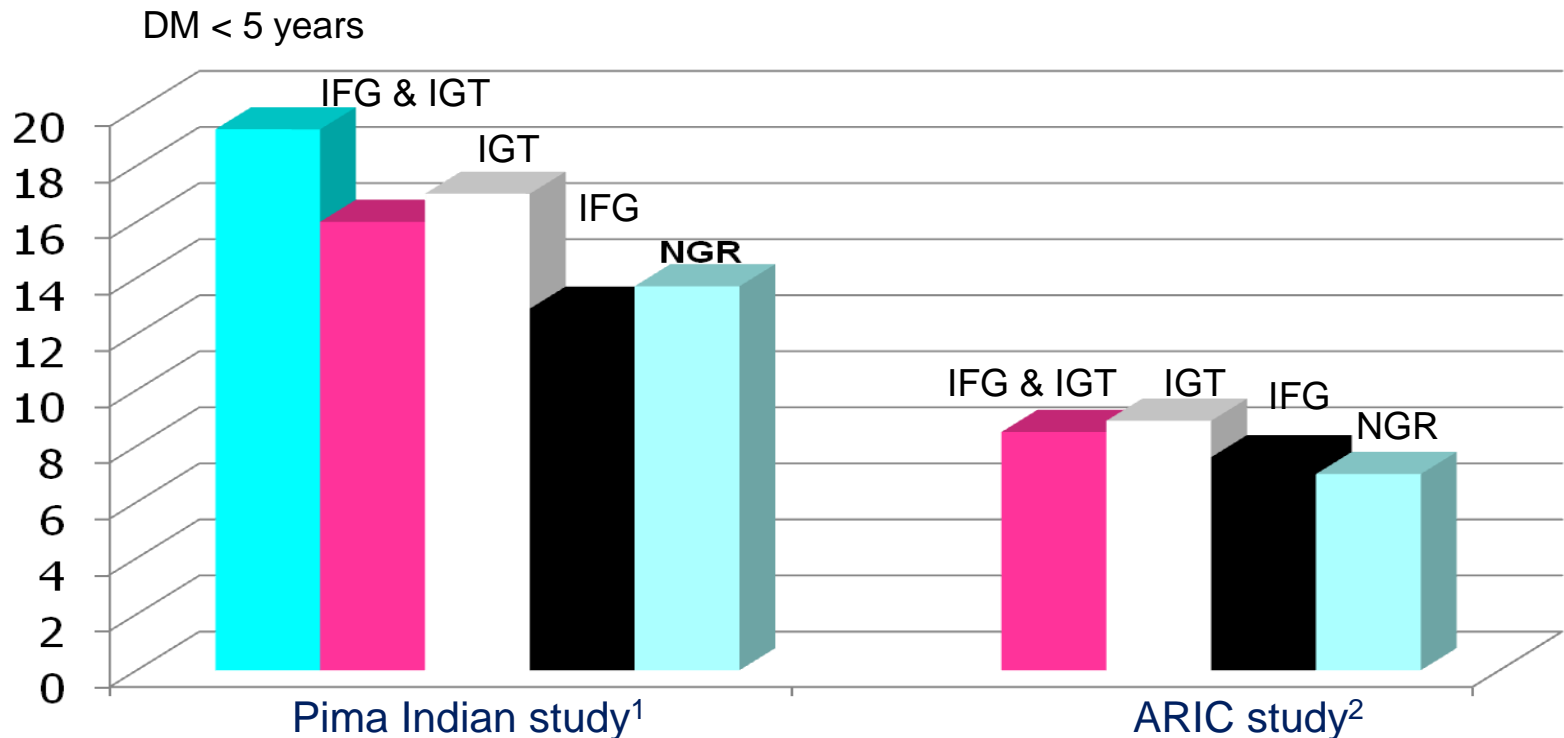
DECODE

2-hour glucose, not FPG, predicted all-cause mortality



Neither IFG nor IGT predicted all-cause mortality

(/1000 person-years)



IFG: impaired fasting glucose
IGT: impaired glucose tolerance

¹Diabetes Care 2008;31:488-492

²Diabetes Care 2007;30:325-331

A report on the diagnosis of intermediate hyperglycemia in Korea: A pooled analysis of four community-based cohort studies

Jee-Young Oh ^{a,1}, Soo Lim ^{b,1}, Dae Jung Kim ^c, Nan Hee Kim ^d, Dong Jun Kim ^e,
Sung Dae Moon ^f, Hak Chul Jang ^b, Young Min Cho ^g, Kee-Ho Song ^h, Chul Woo Ahn ⁱ,
Yeon-Ah Sung ^a, Joong-Yeol Park ^j, Chol Shin ^d, Hong Kyu Lee ^g, Kyong Soo Park ^{g,*}

on behalf of the Committee of the Korean Diabetes Association on the Diagnosis and Classification of Diabetes Mellitus

- stage 1 IFG: FPG: 100~109 mg/dl, stage 2 IFG: FPG: 110~125 mg/dl

Table 4 – Clinical characteristics of subjects with IFG according to the ranges of fasting plasma glucose

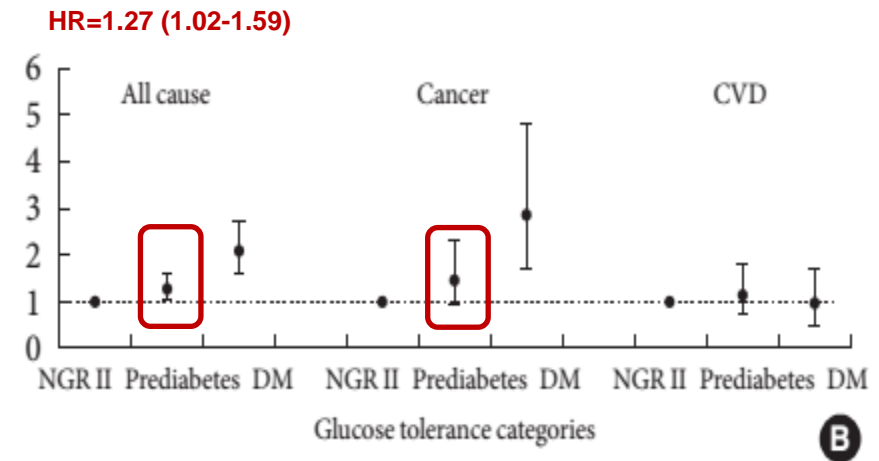
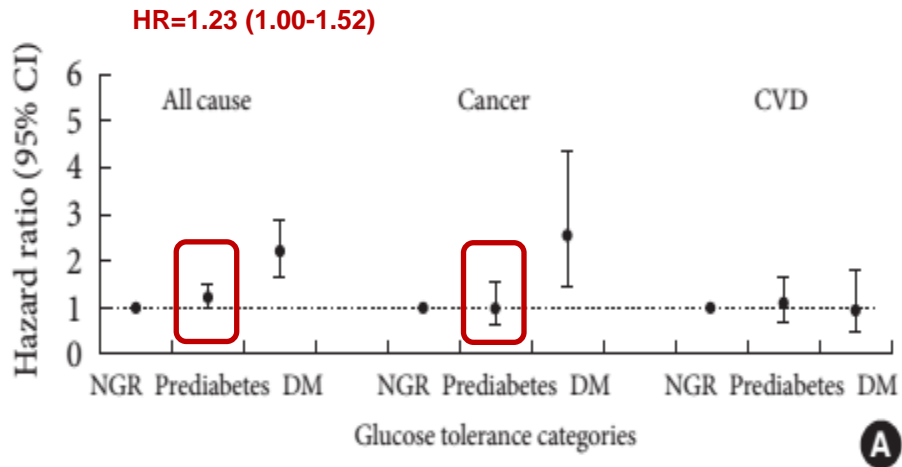
	NFG (n = 3298)	Stage 1 (n = 791)	Stage 2 (n = 333)	P*
Age (years)	51.5 ± 13.5	52.4 ± 14.3	54.6 ± 13.3	B, C
N (%) of male	1243 (37.7%)	327 (41.3%)	160 (48.0%)	<0.001
Weight (kg)	59.6 ± 9.8	60.9 ± 10.7	63.5 ± 10.2	A, B, C
BMI (kg/m ²)	23.6 ± 3.1	23.8 ± 3.3	24.6 ± 3.2	B, C
Waist circumference (cm)	81.5 ± 8.9	83.9 ± 9.5	86.8 ± 8.6	A, B, C
Waist-hip ratio	0.86 ± 0.07	0.88 ± 0.07	0.89 ± 0.06	A, B, C
Systolic BP (mmHg)	125.8 ± 22.2	126.4 ± 21.8	132.6 ± 23.5	B, C
Diastolic BP (mmHg)	79.6 ± 13.1	79.7 ± 13.8	81.9 ± 13.8	NS
Total cholesterol (mmol/L)	4.6 ± 1.0	5.0 ± 1.0	5.1 ± 1.0	A, B, C
Triglyceride (mmol/L)	1.6 ± 1.1	1.7 ± 1.2	1.9 ± 1.3	B
HDL-cholesterol (mmol/L)	1.1 ± 0.3	1.2 ± 0.3	1.1 ± 0.3	A
LDL-cholesterol (mmol/L)	2.7 ± 0.9	3.0 ± 1.0	3.1 ± 1.0	A, B
N (%) of 2-h PG > 11.1 mmol/L	41 (1.2%)	15 (1.9%)	47 (14.1%)	<0.001

HR of death according to glucose categories

	All cause		Cancer		CVD	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
FPG						
5.6 ≤ FPG < 6.1 Stage 1 IFG	0.94 (0.74–1.20)	1.02 (0.80–1.29)	0.60 (0.34–1.06)	0.67 (0.38–1.20)	0.83 (0.51–1.35)	0.82 (0.50–1.34)
6.1 ≤ FPG < 7.0 Stage 2 IFG	1.18 (0.89–1.56)	1.21 (0.91–1.60)	1.33 (0.77–2.29)	1.54 (0.88–2.68)	0.98 (0.54–1.79)	0.87 (0.47–1.59)
FPG ≥ 7.0 or known DM	2.05 (1.57–2.68)	2.16 (1.62–2.87)	2.29 (1.35–3.86)	2.89 (1.66–5.02)	1.10 (0.57–2.11)	0.85 (0.42–1.69)
2hPG						
7.8 ≤ 2hPG < 11.1	1.28 (1.01–1.62)	1.26 (0.99–1.61)	1.41 (0.87–2.29)	1.43 (0.88–2.35)	1.16 (0.72–1.89)	1.11 (0.68–1.82)
2hPG ≥ 11.1 or known DM	1.92 (1.46–2.51)	2.00 (1.51–2.65)	1.84 (1.03–3.29)	2.14 (1.18–3.90)	1.03 (0.53–1.98)	0.83 (0.41–1.66)

Values are presented as hazard ratios (95% confidence interval). Reference group: FPG < 5.6 mmol/L, 2hPG < 7.8 mmol/L. Model 1, adjusted for age, sex, and study center. Model 2, adjusted for age, sex, study center, body mass index, systolic blood pressure, total cholesterol, high density lipoprotein cholesterol, and smoking status.

HR of death according to glucose categories



	NGR I	prediabetes	DM
FPG	<100	100~125	≥126
2hPG	<140	140~199	≥200

	NGR II	Prediabetes II	DM
FPG	<110	110~125	≥126
2hPG	<140	140~199	≥200

Conclusion

- Diabetes is a significant risk factor for both all-cause and cancer mortality
- In subjects with stage 2 IFG and/or IGT, the rates of all-cause mortality increase relative to NGR II

Acknowledgement

- The Committee on the Epidemiology of Korean Diabetes Association
 - Chairman: prof. Yong Soo Park
 - 22 committee members
 - prof. Dong-Jun Kim, Seok Won Park, Jee-Young Oh
- Principal Investigator of each cohort
 - Yonchon cohort :pf. Hong Kyu Lee
 - Chungup cohort :pf. Joong Youl Park
 - Ansan cohort:pf. Chol Shin
- Financial support by Korean Diabetes Association

Thank you for your attention!



Diabetes Epidemics in Korea: Reappraise Nationwide Survey of Diabetes “Diabetes in Korea 2007”

In 2006, The Committee on the Epidemiology of DM in KDA collaborated with Health Insurance Review & Assessment Service to evaluate the status of diabetes care

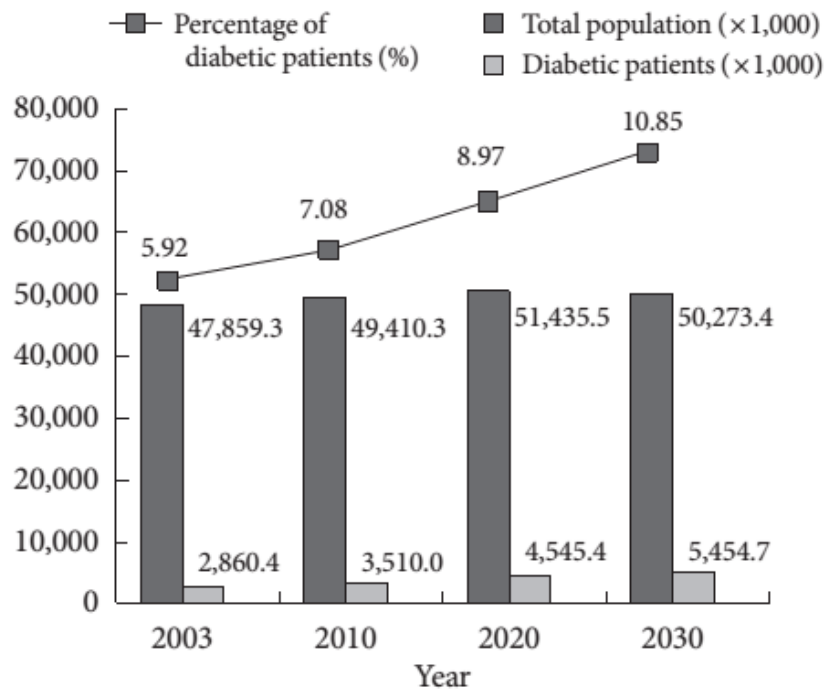


Fig. 2. Diabetic population estimates from 2003 to 2030 in Korea.

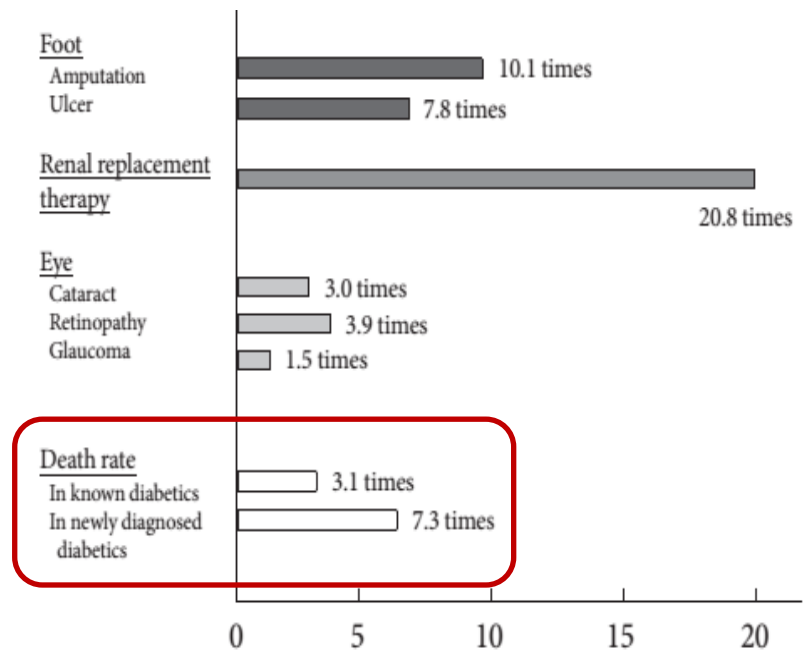


Fig. 4. Relative risk of comorbidities and health outcome compared with nondiabetics by simple comparison.