

# Urban-rural variation in Metabolic syndrome components in Thai adults

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And the NHES IV study group



# Background

- MetS was associated with increased risk of mortality and CVD.
- The prevalence of metabolic syndrome in Thai population aged  $\geq 35$  yrs in 4 provinces =32.6% (men 28.7%, women 36.4%) InterAsia.
- Prevalence of the clustering of MetS components varied by age and sex.
- Some studies (eg. China and India) have reported the higher prevalence of MetS among urban population than in rural areas.
- It is not clear how the various combinations of MetS components varied by urban/rural population and if particular combinations of metabolic components are more common in urban or rural populations.
- Understanding the distribution of clustering of MetS components would benefit the design of specific interventions to prevent and control the conditions for the population.



# MetS, a heterogeneous group of MetS component

**Table 1 – Age-adjusted prevalence (%) of metabolic syndrome components and their combinations with the modATPIII definition and in those with abdominal obesity with the IDF definition by sex and study population**

Combinations of MetS components	Australia		Japan		Korea		Samoa	
	M	F	M	F	M	F	M	F
<b>modATPIII 3 components</b>								
WC + TG + HDL	0.8	1.7	0.04	0.4	0.01	2.7	0.7	1.7
WC + TG + BP	2.4	2.8	0	0	0.1	1.4	0.5	0.5
WC + TG + FPG	1.0	0.7	0.1	0.1	0	0.3	1.2	0.6
WC + HDL + BP	0.7	1.3	0	0.8	0.1	2.6	2.0	4.6
WC + HDL + FPG	0.4	0.9	0	0.4	0.01	0.3	3.6	10.5
WC + BP + FPG	5.4	4.5	0	0.9	0.3	0.9	6.9	7.7
TG + HDL + BP	1.6	1.0	1.4	1.8	3.7	3.8	0	0.2
TG + HDL + FPG	1.7	0.5	2.0	0.6	1.8	1.0	1.6	0.5
TG + BP + FPG	4.7	1.1	3.3	0.6	3.7	0.4	0.8	0.2
HDL + BP + FPG	0.8	0.4	0.7	2.7	0.5	0.6	1.9	1.4
<b>4 components</b>								
WC + TG + HDL + BP	1.8	2.4	0.01	0.6	0.1	3.8	0.5	2.2
WC + TG + HDL + FPG	1.4	1.1	0.3	0.1	0.01	0.8	3.2	3.7
WC + TG + BP + FPG	5.3	3.2	0	0	0.2	0.5	2.7	1.5
WC + HDL + BP + FPG	1.1	1.7	0	0.3	0.03	0.8	6.1	12.7
TG + HDL + BP + FPG	2.4	0.9	1.5	0.9	1.9	1.2	1.4	0.7
<b>5 components</b>								
WC + TG + HDL + BP + FPG	4.3	4.3	0	0.1	0.2	1.7	6.2	8.7
Prevalence of MetS	35.8	28.5	9.4	10.3	12.7	22.8	39.3	57.2



# Metabolic Syndrome and Cardiovascular Risk

- Metabolic syndrome was associated with an increased risk of
- CVD (RR: 2.35, 95% CI: 2.02 - 2.73),
- CVD mortality (RR: 2.40, 95% CI: 1.87 - 3.08),
- All-cause mortality (RR: 1.58, 95% CI: 1.39 - 1.78),
- Myocardial infarction (RR: 1.99; 95% CI: 1.61 -2.46),
- Stroke (RR: 2.27; 95% CI: 1.80 to 2.85).



Comparison group vs. absence	CVD	All-cause mortality
	HR (95% CI)	HR (95% CI)
Definitions of the metabolic syndrome		
Updated ATP III	2.41 (1.67–3.51)	1.60 (1.23–2.09)
IDF	2.14 (1.39–3.28)	1.39 (1.01–1.91)
Qualifying sets of components		
Central obesity, high TG, and low HDL	2.12 (1.21–3.74)	1.27 (0.81–1.98)
Central obesity, high TG, and high BP	2.31 (1.37–3.91)	1.58 (1.08–2.32)
Central obesity, high TG, and high FPG	3.05 (1.56–5.95)	2.20 (1.37–3.54)
Central obesity, low HDL, and high FPG	4.24 (2.08–8.64)	1.98 (1.10–3.59)
Central obesity, low HDL, and high BP	2.45 (1.34–4.48)	1.26 (0.76–2.09)
Central obesity, high BP, and high FPG	4.35 (2.38–7.96)	2.19 (1.34–3.58)
High TG, low HDL, and high BP	2.57 (1.59–4.13)	1.66 (1.17–2.36)
High TG, low HDL, and high FPG	2.93 (1.55–5.53)	1.83 (1.13–2.97)
High TG, high BP, and high FPG	3.16 (1.77–5.63)	2.09 (1.38–3.19)
Low HDL, high BP, and high FPG	4.60 (2.53–8.36)	1.93 (1.14–3.28)
Central obesity, high TG, high FPG, and low HDL	4.01 (1.82–8.84)	1.87 (0.95–3.68)
Central obesity, high TG, high BP, and low HDL	2.25 (1.15–4.41)	1.38 (0.81–2.35)
Central obesity, high TG, high BP, and high FPG	3.92 (1.94–7.92)	2.13 (1.21–3.76)
Central obesity, high BP, high FPG, and low HDL	5.98 (2.80–12.75)	2.01 (0.98–4.13)
High TG, high BP, high FPG, and low HDL	4.39 (2.19–8.83)	2.16 (1.20–3.88)
Central obesity, high TG, high BP, high FPG, and low HDL	5.61 (2.39–13.14)	2.00 (0.88–4.55)
Each component adjusted for all others		
High TG	0.96 (0.65–1.41)	1.01 (0.78–1.30)
Low HDL	1.30 (0.88–1.91)	1.13 (0.87–1.47)
High BP	2.15 (1.47–3.15)	1.47 (1.15–1.88)
Central obesity	1.45 (0.96–2.20)	1.03 (0.76–1.39)
High FPG	1.67 (1.11–2.51)	1.57 (1.19–2.07)

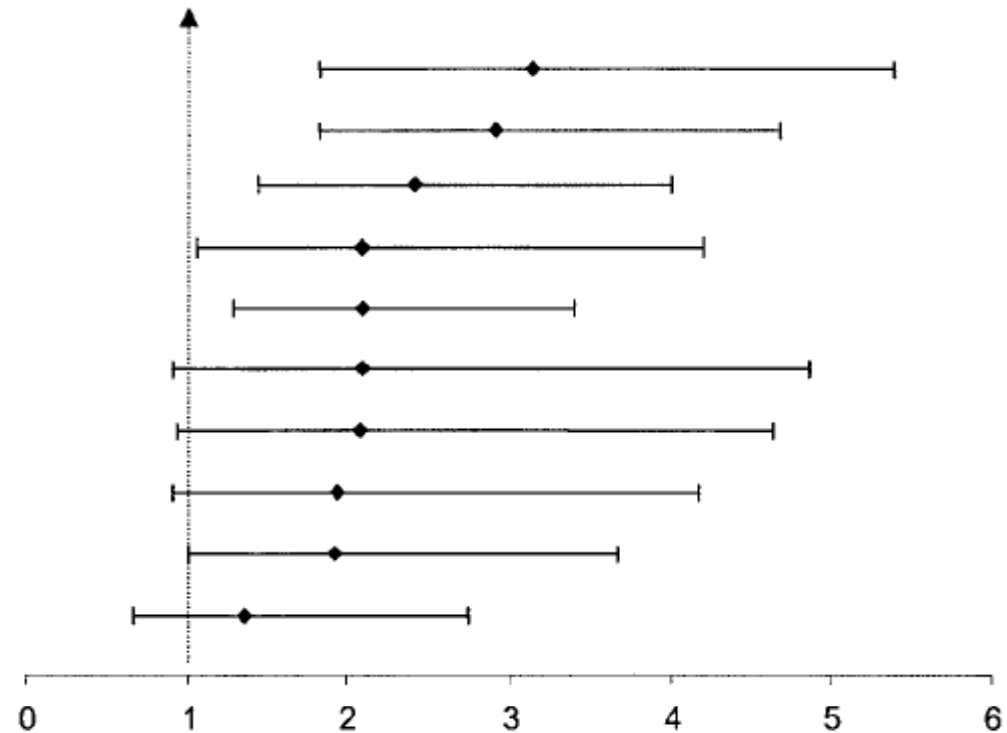
Tanomsup S, et al. Diabetes Care. 2007;30:2138-40.



# HR (95% CI) for all-cause mortality ass. With MetS components

## B NCEP-R

W+TG+G	2235	8.7%
W+BP+G	4271	47.8%
W+TG+BP	3142	29.1%
TG+HDL+G	1316	16.6%
TG+BP+G	5573	54.9%
W+HDL+G	881	7.6%
W+TG+HDL	896	9.0%
W+HDL+BP	1232	18.6%
HDL+BP+G	1662	22.7%
TG+HDL+BP	1746	26.4%



Adjusted for age, sex, current smoking status, LDL cholesterol levels, declared physical activity, and socioprofessional category



# Objectives

- Determine prevalence of metabolic syndrome and its components by sex, age group, urban/rural areas and regions among Thai adults.



# Sample

- Sample from NHES4, Non-institutionalized of registered population
- Multi-stage random sampling of 20 000 individuals age 20+ yr
- 5 provinces / regions + Bangkok = 21 provinces





# NHES procedure

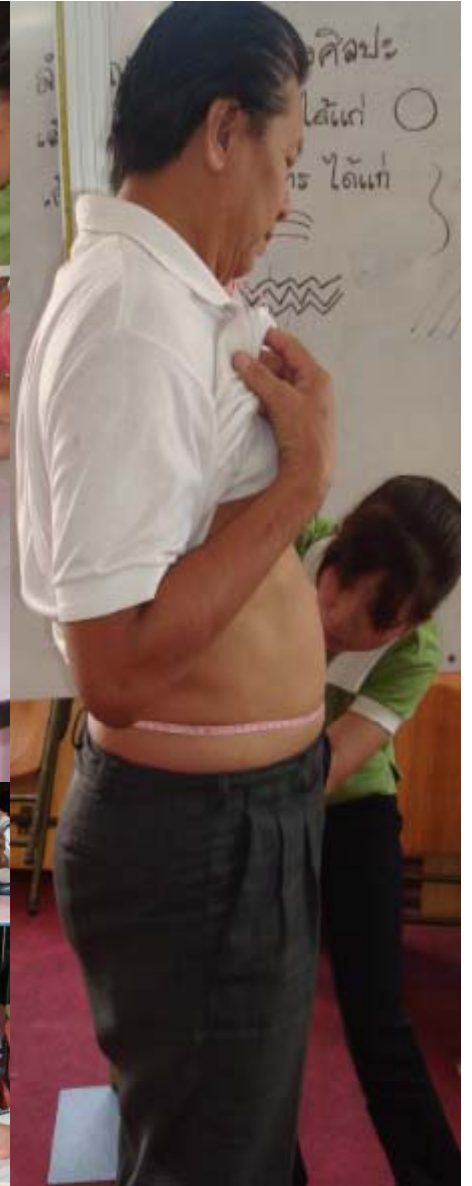
- Ascertain selected individuals at their household to ask for permission and consent
- Interview and examination at local health centers, schools or temples in the community
  - Blood pressure measurement
  - Anthropometry
  - Blood samples,
- Administered by trained personnel



# Definition: Metabolic Syndrome

- Waist circumference:
  - Men  $\geq 90$  cm, Women  $\geq 80$  cm
- Triglycerides  $>150$  mg/dL
- HDL cholesterol:
  - Men  $<40$  mg/dL
  - Women  $<50$  mg/dL
- Blood pressure  $\geq 130/85$  mm Hg
- Fasting glucose  $>100$  mg/dL\*





# Results



# Means of selected metabolic risk factors

	Men				Women			
	Urban		Rural		Urban		Rural	
	Absent n=3414	Present n=1404	Absent n=3398	Present n=937	Absent n=3604	Present n=2031	Absent n=2888	Present n=1580
<b>Age (yr)</b>	45.6	51.0 <sup>a,c</sup>	44.0	49.3 <sup>a,d</sup>	45.1	54.1 <sup>b,c</sup>	43.1	52.1 <sup>b,d</sup>
<b>SBP (mmHg)</b>	122.6	135.7 <sup>a,c</sup>	121.0	133.7 <sup>a,d</sup>	115.8	128.6 <sup>c</sup>	115.8	129.7 <sup>d</sup>
<b>DBP (mmHg)</b>	76.9	85.7 <sup>a,c</sup>	74.6	82.9 <sup>a,d</sup>	71.7	78.6 <sup>c</sup>	71.6	79.8 <sup>d</sup>
<b>BMI (kg/m<sup>2</sup>)</b>	23.0	28.8 <sup>a,c</sup>	22.1	28.0 <sup>a</sup>	23.8	28.8 <sup>b,c</sup>	23.0	27.4 <sup>b</sup>
<b>Waist (cm)</b>	80.0	96.1 <sup>a,c</sup>	76.3	92.7 <sup>a,d</sup>	77.2	90.0 <sup>b,c</sup>	75.4	87.1 <sup>b,d</sup>
<b>FPG (mg/dL)</b>	87.5	109.1 <sup>a,c</sup>	85.9	106.3 <sup>a</sup>	84.4	105.1 <sup>b,c</sup>	84.7	99.4 <sup>b</sup>
<b>HDL (mg/dL)</b>	48.9	39.3 <sup>a,c</sup>	46.6	36.6 <sup>a,d</sup>	53.9	41.9 <sup>b,c</sup>	50.0	42.3 <sup>b,d</sup>
<b>TG (mg/dL)</b>	137.1	257.5 <sup>a,c</sup>	148.4	282.5 <sup>a,d</sup>	104.8	194.3 <sup>b,c</sup>	117.8	207.0 <sup>b,d</sup>

\*Age-adjusted: direct adjustment using Thai registered population 2008

a Statistically significant difference between men in urban and rural areas at P<0.05

b Statistically significant difference between women in urban and rural areas at P<0.05

c Statistically significant difference between men and women in urban area at P<0.05

d Statistically significant difference between men and women in rural area at P<0.05

BMC Public Health. 2011;10;11:854



	Men				Women			
	Urban		Rural		Urban		Rural	
	Absent n=3414	Present n=1404	Absent n=3398	Present n=937	Absent n=3604	Present n=2031	Absent n=2888	Present n=1580
<b>Educational level (%)</b>								
< high school	58.0	61.7 <sup>a,c</sup>	78.7	77.4 <sup>a,d</sup>	61.9	76.7 <sup>b,c</sup>	79.5	88.4 <sup>b,d</sup>
<b>Leisure time physical activity (min/week) (%)</b>								
<150	67.2	73.9	73.7	70.6 <sup>d</sup>	79.6	80.1	83.1	81.2 <sup>d</sup>
<b>Regular smoking (%)</b>								
Yes	35.2	30.4 <sup>a,c</sup>	45.0	40.8 <sup>a,d</sup>	2.6	4.9 <sup>b,c</sup>	2.2	1.0 <sup>b,d</sup>
<b>Alcohol drinking (%)</b>								
≥41 g/d men ≥21 g/d in women	15.6	18.9 <sup>c</sup>	13.9	13.9 <sup>d</sup>	2.4	1.5 <sup>b,c</sup>	1.4	0.9 <sup>b,d</sup>



\*Age-adjusted: direct adjustment using Thai registered population 2008

a Statistically significant difference between men in urban and rural areas at P<0.05

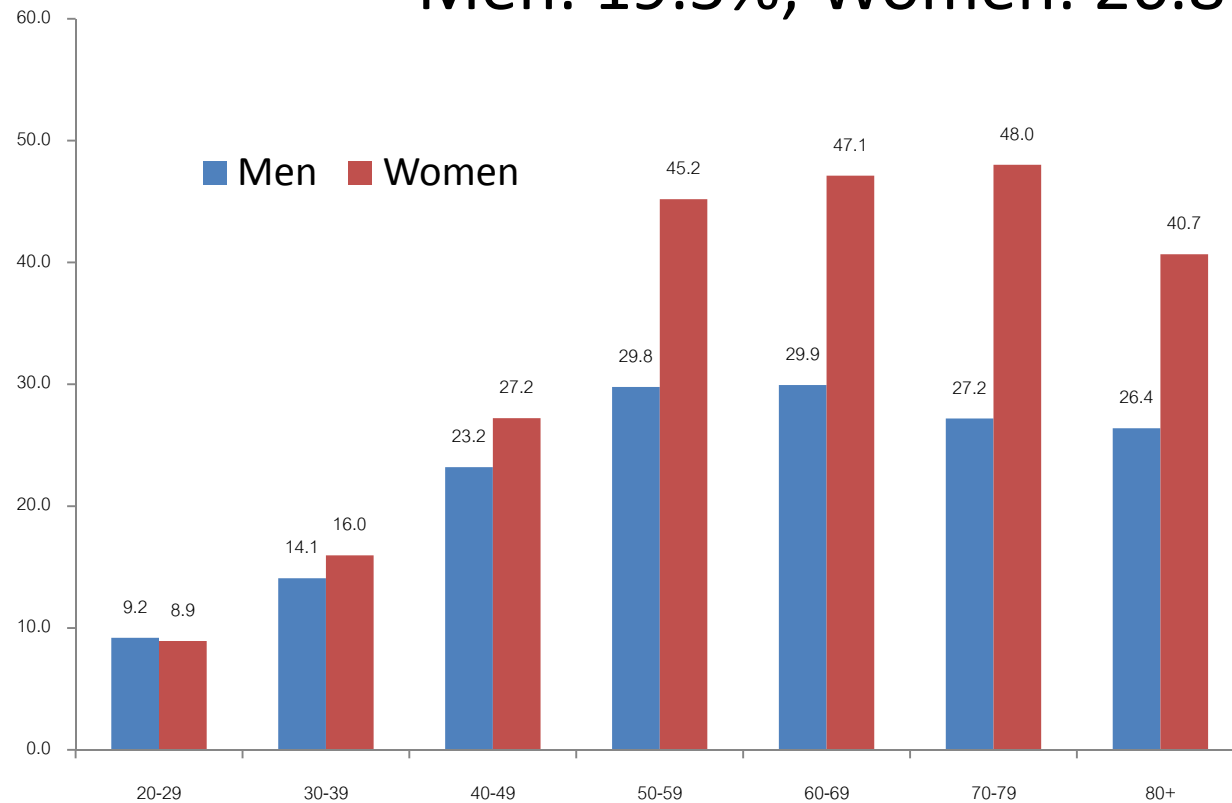
b Statistically significant difference between women in urban and rural areas at P<0.05

c Statistically significant difference between men and women in urban area at P<0.05

d Statistically significant difference between men and women in rural area at P<0.05

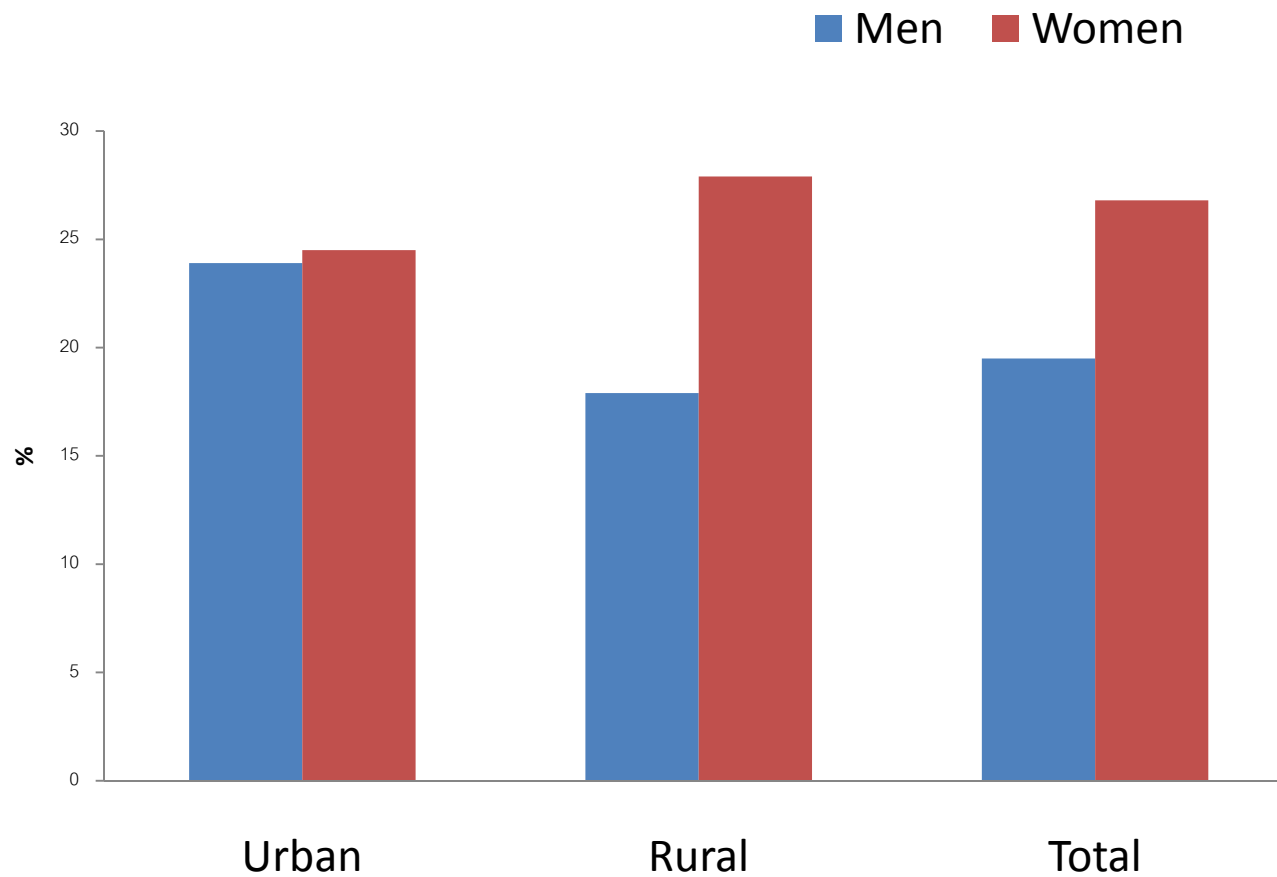
# Age-specific prevalence of Metabolic syndrome in Thai adults aged $\geq 20$ yrs, NHES IV, 2009

Men: 19.5%; Women: 26.8%



Aekplakorn W, et al. BMC Public Health. 2011;10;11(1):854

# Prevalence of Metabolic syndrome in Thai adults aged $\geq 20$ by sex



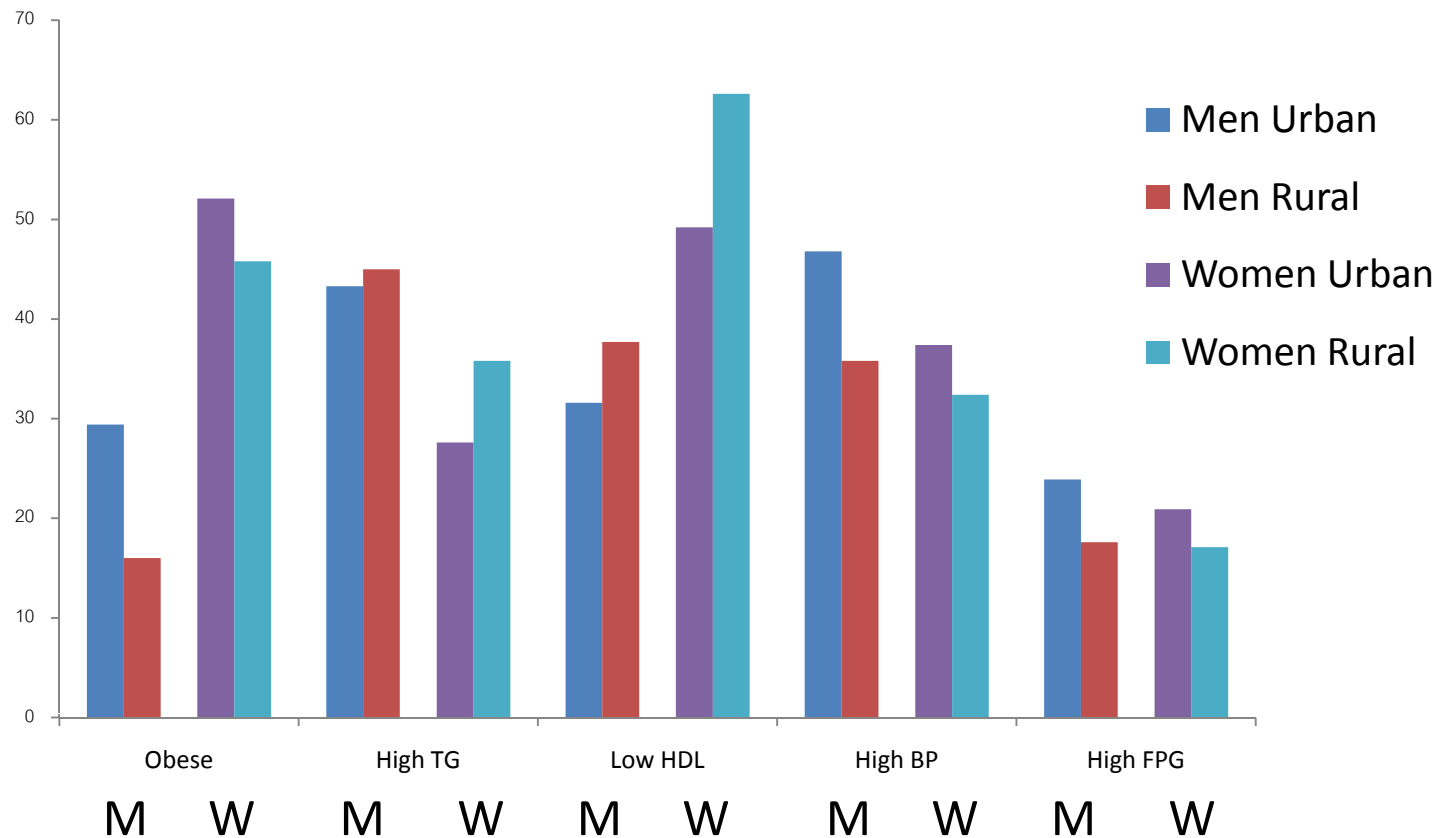
BMC Public Health. 2011;10;11(1):854



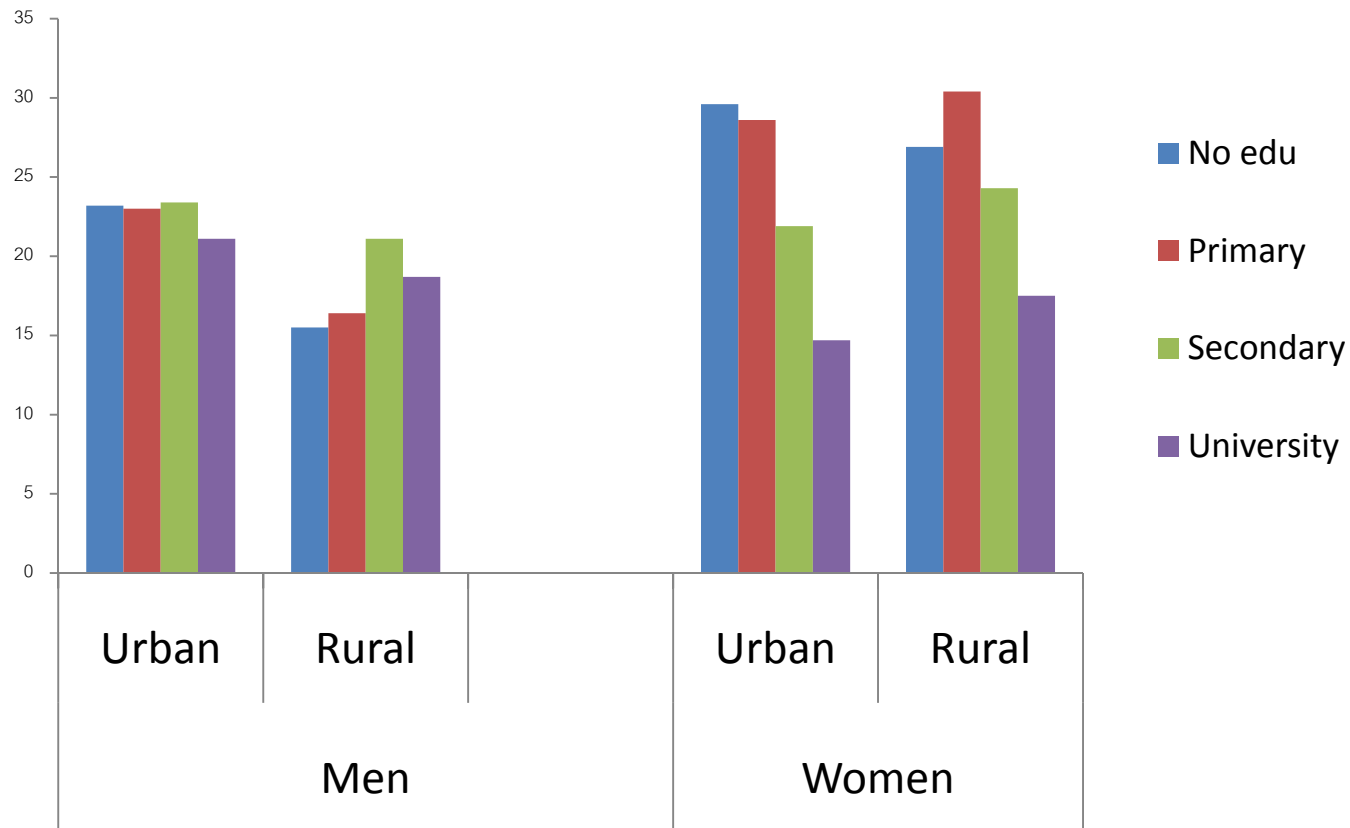




# Prevalence of Mets component by sex and area of residence, NHES IV, 2009



# Education and Metabolic syndrome





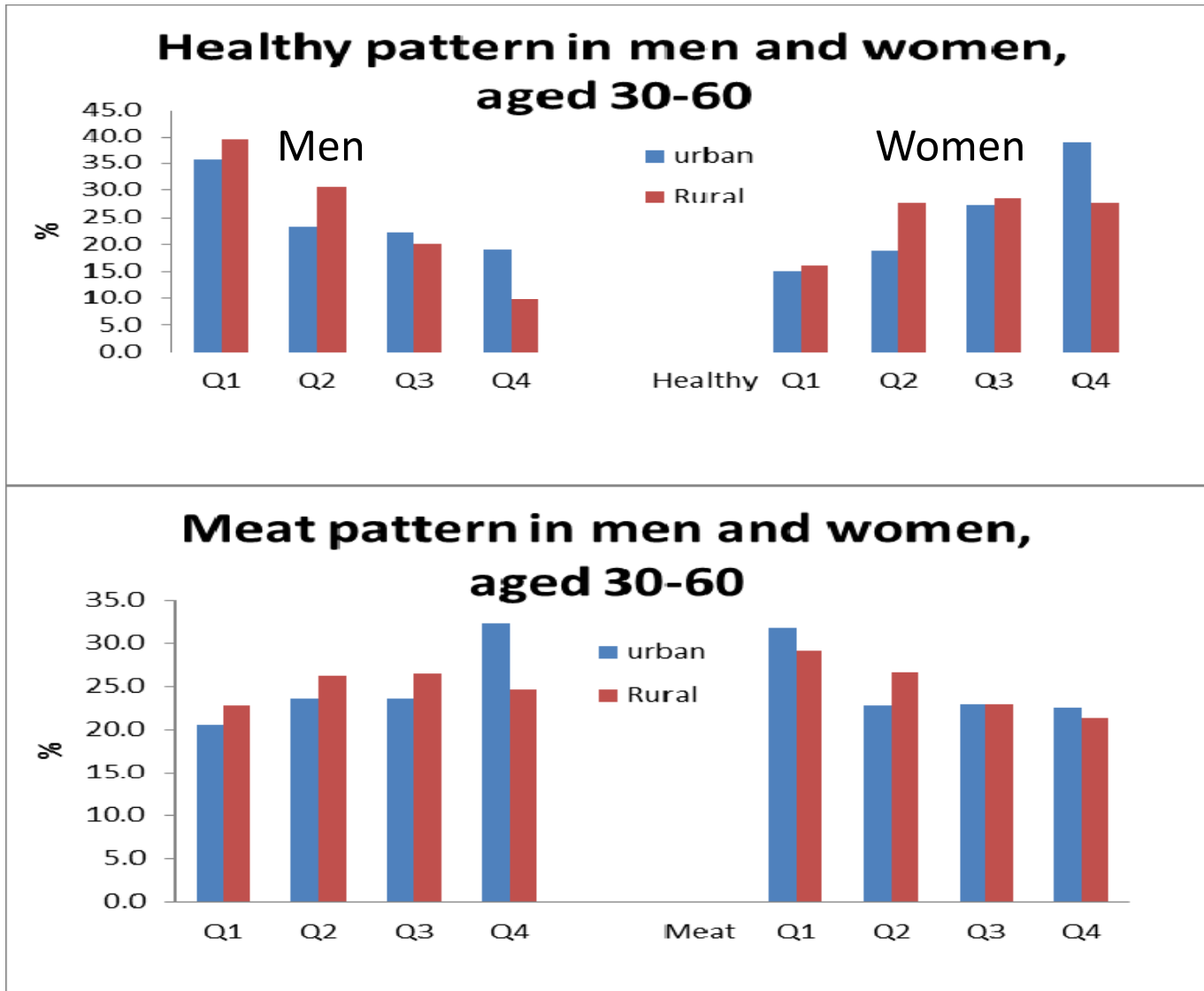


## Adjusted OR (95%CI) for factors associated with MetS

Factors	Male	Women
Age (yr)	1.05 (1.04, 1.06)	1.06 (1.05, 1.06)
Urban (rural as ref)	0.92 (0.79, 1.08)	0.70(0.61, 0.80)
Education < high school ( $\geq$ higher as ref)	1.21 (1.03, 1.41)	1.60 (1.33, 1.93)
Smoking (no as ref)	1.13 (0.97, 1.33)	1.05 (0.62, 1.79)
Alc drink $\geq$ 40 g/d men/ $\geq$ 20 gm/d women vs less	1.52 (1.19, 1.94)	1.02 (0.69, 1.51)
Leisure time PA <150 min vs $\geq$ 150 as ref.)	1.16 (0.98, 1.37)	0.92 (0.79, 1.06)
BMI (per kg/m <sup>2</sup> )	1.48 (1.44, 1.51)	1.26 (1.23, 1.29)

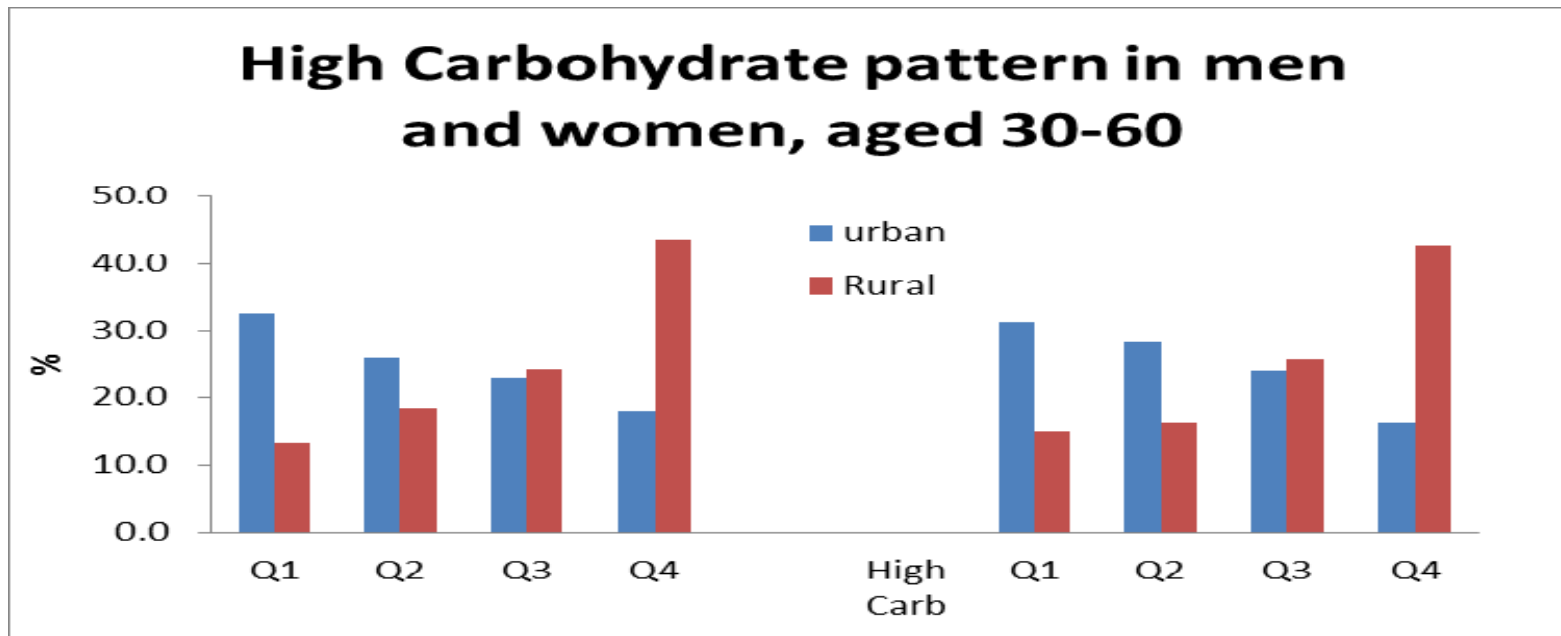


# Dietary pattern





# Dietary pattern



# Summary

- Prevalence Mets:
  - Men: 19.5% (Urban: 23.1% vs Rural: 17.9%)
  - Women: 26.8% (Urban: 24.5% vs Rural: 27.9%)
- The most common combinations
  - Men: **HDL + TG**+ BP (urban: 3.4% vs. rural: 3.9%)
  - Women: **HDL + TG** + Obese (urban: 3.9% vs rural: 5.9%)
  - Urban > Rural
    - Men: **BP +WC**+ (TG, FG, HDL), 5 components
    - Women: **FG+WC**+HDL, 5 components
  - Rural > Urban
    - Men: **HDL+TG**+BP, **HDL+TG**+BP+FG
    - Women: **HDL+ TG** +Obese, **HDL+TG**+BP, **HDL+TG**+Obese+BP



**Table 4.** Age-Standardized Prevalence (Standard Error) of Participants With All Possible Combinations of MetS Components

Combination of MetS	Men (n = 2093)			Women (n = 3212)			
	Total	Urban	Rural	Total	Urban	Rural	Total
HDL_HTG_HG	2.8 (0.4)	3.2 (1.1)	4.3 (0.9)	3.9 (0.7) <sup>a</sup>	1.2 (0.3)	1.7 (0.5)	1.5 (0.3)
HDL_HTG_HBP	2.8 (0.5)	1.4 (0.4) <sup>b</sup>	4.5 (1.2)	3.6 (0.9)	0.6 (0.3) <sup>b</sup>	2.5 (0.7)	1.9 (0.5)
HDL_HG_HBP	0.6 (0.1)	0.4 (0.1)	0.7 (0.2)	0.6 (0.2)	0.8 (0.2)	0.5 (0.2)	0.6 (0.1)
HTG_HG_HBP	1.3 (0.3)	3.0 (0.7)	2.3 (0.8)	2.5 (0.6) <sup>a</sup>	0.4 (0.1) <sup>b</sup>	0.0	0.1 (0.1)
O_HDL_HTG	4.3 (0.7)	1.6 (0.5)	2.0 (0.8)	1.9 (0.6) <sup>a</sup>	4.7 (1.2)	7.6 (1.7)	6.6 (1.2)
O_HDL_HG	2.2 (0.4)	0.5 (0.3)	1.2 (0.6)	1.0 (0.4) <sup>a</sup>	3.8 (0.5)	3.1 (1.0)	3.4 (0.7)
O_HDL_HBP	2.1 (0.3)	1.3 (0.3)	0.4 (0.3)	0.6 (0.2) <sup>a</sup>	2.7 (0.4)	4.0 (0.7)	3.6 (0.5)
O_HTG_HG	0.5 (0.1)	0.9 (0.3)	0.4 (0.2)	0.5 (0.2)	1.0 (0.2) <sup>c</sup>	0.3 (0.1)	0.5 (0.1)
O-TG_HBP	0.8 (0.2)	2.3 (0.7) <sup>b</sup>	0.6 (0.5)	1.2 (0.4)	0.4 (0.2)	0.6 (0.3)	0.5 (0.2)
O_HG_HBP	1.6 (0.2)	3.6 (0.6) <sup>d</sup>	1.1 (0.4)	1.9 (0.4)	3.5 (0.6) <sup>d</sup>	0.3 (0.2)	1.3 (0.3)
O_HDL_HTG_HG	3.0 (0.3)	1.4 (0.4)	2.1 (0.7)	1.9 (0.5) <sup>a</sup>	5.4 (0.9)	3.6 (0.5)	4.2 (0.5)
O_HDL_HG_HBP	1.5 (0.2)	1.8 (0.5) <sup>b</sup>	0.5 (0.3)	0.9 (0.3) <sup>c</sup>	2.9 (0.5)	1.8 (0.5)	2.2 (0.4)
O_HDL_HTG_HBP	2.7 (0.3)	2.5 (0.5) <sup>b</sup>	1.2 (0.4)	1.6 (0.4) <sup>a</sup>	2.3 (0.4) <sup>b</sup>	4.5 (0.8)	3.8 (0.6)
O_HTG_HG_HBP	1.4 (0.3)	3.3 (0.8) <sup>b</sup>	1.3 (0.6)	1.9 (0.5)	2.1 (0.3) <sup>d</sup>	0.4 (0.2)	0.9 (0.2)
HDL_HTG_HG_HBP	1.5 (0.2)	2.1 (0.5)	1.8 (0.4)	1.9 (0.4) <sup>a</sup>	1.8 (0.2) <sup>b</sup>	0.6 (0.1)	1.0 (0.2)
O_HDL_HTG_HG_HBP	3.5 (0.4)	3.9 (0.5) <sup>b</sup>	2.1 (0.6)	2.7 (0.5) <sup>c</sup>	4.4 (0.6)	4.3 (0.9)	4.3 (0.7)

Abbreviations: MetS, metabolic syndrome; HDL, low high-density lipoprotein cholesterol (<40 mg/dL in men or <50 mg/dL in women); HTG, high triglycerides ( $\geq 150$  mg/dL or on treatment); HG, hyperglycemia (fasting plasma glucose  $\geq 100$  mg/dL and diabetes); HBP, high blood pressure (systolic BP  $\geq 130$  mm Hg and/or diastolic BP  $\geq 90$  mm Hg; O, abdominal obesity (waist circumference  $\geq 90$  cm in men and  $\geq 80$  cm in women).



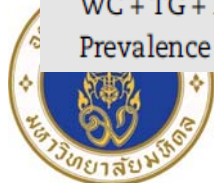
# MetS, a heterogeneous group of MetS component

**Table 1 – Age-adjusted prevalence (%) of metabolic syndrome components and their combinations with the modATPIII definition and in those with abdominal obesity with the IDF definition by sex and study population**

Combinations of MetS components	Thai		U S		Australia		Japan		Korea		Samoa		M	F
	M	F	M	F	M	F	M	F	M	F	M	F		
	modATPIII 3 components													
WC + TG + HDL	2.3	5.4	2.2	4.2	0.8	1.7	0.04	0.4	0.01	2.7	0.7	1.7	1.9	6.6
WC + TG + BP	1.7	1.3	1.4	1.9	2.4	2.8	0	0	0.1	1.4	0.5	0.5		
WC + TG + FPG					1.0	0.7	0.1	0.1	0	0.3	1.2	0.6		
WC + HDL + BP					0.7	1.3	0	0.8	0.1	2.6	2.0	4.6		
WC + HDL + FPG					0.4	0.9	0	0.4	0.01	0.3	3.6	10.5		
WC + BP + FPG					5.4	4.5	0	0.9	0.3	0.9	6.9	7.7		
TG + HDL + BP	4.1	2.4	4.8	1.0	1.6	1.0	1.4	1.8	3.7	3.8	0	0.2	3.6	1.9
TG + HDL + FPG					1.7	0.5	2.0	0.6	1.8	1.0	1.6	0.5		
TG + BP + FPG					4.7	1.1	3.3	0.6	3.7	0.4	0.8	0.2		
HDL + BP + FPG					0.8	0.4	0.7	2.7	0.5	0.6	1.9	1.4		
4 components														
WC + TG + HDL + BP	2.5	4.6	3.6	2.8	1.8	2.4	0.01	0.6	0.1	3.8	0.5	2.2	1.6	3.8
WC + TG + HDL + FPG					1.4	1.1	0.3	0.1	0.01	0.8	3.2	3.7		
WC + TG + BP + FPG					5.3	3.2	0	0	0.2	0.5	2.7	1.5		
WC + HDL + BP + FPG					1.1	1.7	0	0.3	0.03	0.8	6.1	12.7		
TG + HDL + BP + FPG					2.4	0.9	1.5	0.9	1.9	1.2	1.4	0.7		
5 components														
WC + TG + HDL + BP + FPG	1.7	3.0	3.6	3.0	4.3	4.3	0	0.1	0.2	1.7	6.2	8.7	2.7	4.3
Prevalence of MetS					35.8	28.5	9.4	10.3	12.7	22.8	39.3	57.2		

Lee CMY et al. Diab Res Clin Prac 2008;81:377-80. *Diabetes Care* 33:2457-2461, 2010

BMC Public Health. 2011;10:11:854 *Asia Pac J Public Health* 2011 23: 792



# Discussion

- MetS in US 2003-6: Men: 41.9%, women:35.0%. (using WC criteria of  $\geq 94$  cm in men and  $\geq 80$  in women for White, African American, and other participants and  $\geq 90$  cm in men and  $\geq 80$  cm in women for Mexican American) (*Journal of Diabetes 2 (2010) 180–193*)
- MetS in Korea 2007: Male: 29.0% women: 32.9% (*Diabetes Care 34:1323–1328,2011*)
- The prevalence among aged  $\geq 35$  was not significantly different from that of InterAsia (30.0%, men 24.7 women 34.9)
- The variation of Mets combination by urban/rural was consistent with findings from InterAsia study. (*Asia Pac J Public Health 2011 23: 792*)
- The common MetS by sex was consistent with NHANES: The most prevalent MetS combination (*Diabetes Care 33:2457–2461, 2010*)
  - Men: Low HDL + High TG + High BP
  - Women:Low HDL +High TG + Abd Obese
- The variations in components are likely to be related to life style.
- Dyslipidemia is more common in rural areas.
- Management of obesity and dyslipidemia should be strengthen.



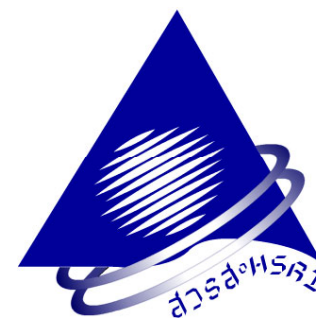
# Acknowledgement



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