Socio-economic inequality and mortality in Taiwan
the prospective MJ Health Study

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inequality or disparity
Study

- Two questions:

- **1) How large is the gap?**

- **2) Is the gap narrowing?**

- Very limited studies in Asian population

    - **Japanese study**
        - 32,883 subjects
        - Hazard ratios adjusted for age, body mass index, radiation dose and city
        - All-cause mortality, liver and prostate cancer incidence in men and lung cancer in women

    - **Korea study** (10 leading causes of death)
        - 1995 Census and 1995-2000 death certificates data
        - Age and sex specific mortality rates and relative risks
        - Educational differential in mortality in most causes of death

- Existing scientific evidence is primarily based on European and North America populations

Educational Levels

- 1) Middle school - ≦ 9 years   國中以下

- 2) High school – 12 years   高中

- 3) Junior college – 15 years   專科

- 4) University or higher – 16+ years   大學以上

- 1) 27%

- 2) 24%

- 3) 22%

- 4) 27%

- 2) – 1) = 3 years; 3) - 1) = 6 years; 4) – 1) = 7 years

- Average difference of 7+ years between the highest and lowest groups

Advantages of Using Education as SES Indicator

- Education is available for all individuals

  – Health is less likely to affect educational attainment

  – Asians have for centuries placed great emphasis on education

- Occupation

  – One changes occupation several times in one's life time

  – Missing data in old age after retirement

- Income;

  – People are reluctant to reveal their income

Study Population

- A large cohort from 1994 to 2007

- Medical screening program

- **399,819 adults**

  - Lifestyle risk factors from questionnaire

  - Blood, urine and physical exam data

- **10,054 deaths** identified

  - Matched with National death file

- An average of 8 year follow up
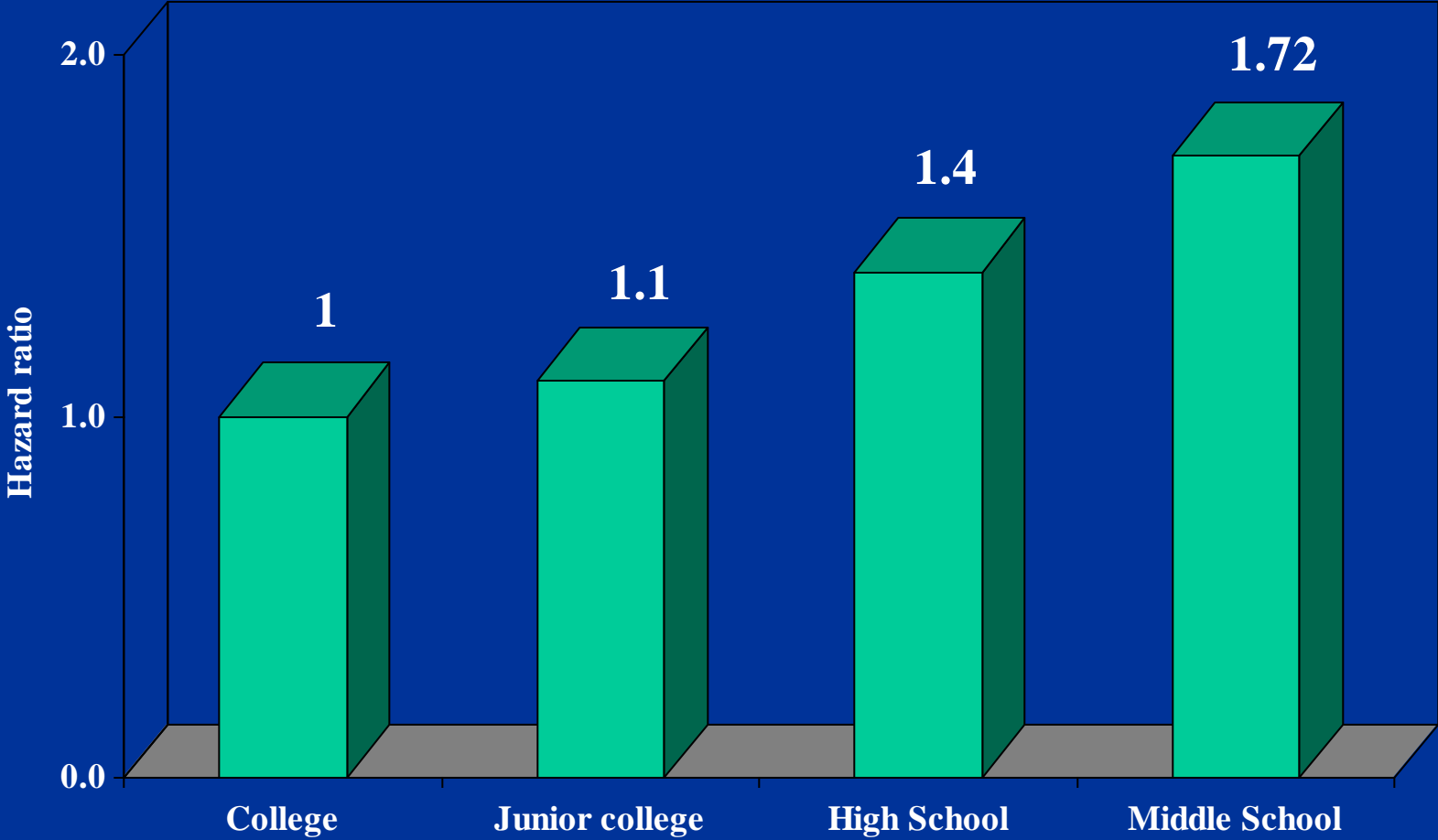
Life Expectancy by educational levels

(men)

For every additional year of education beyond middle school,
life span is increased by one year

Added years in life expectancy with increasing education

≦ 9 years

9 +3 years

9 +6

9 +7
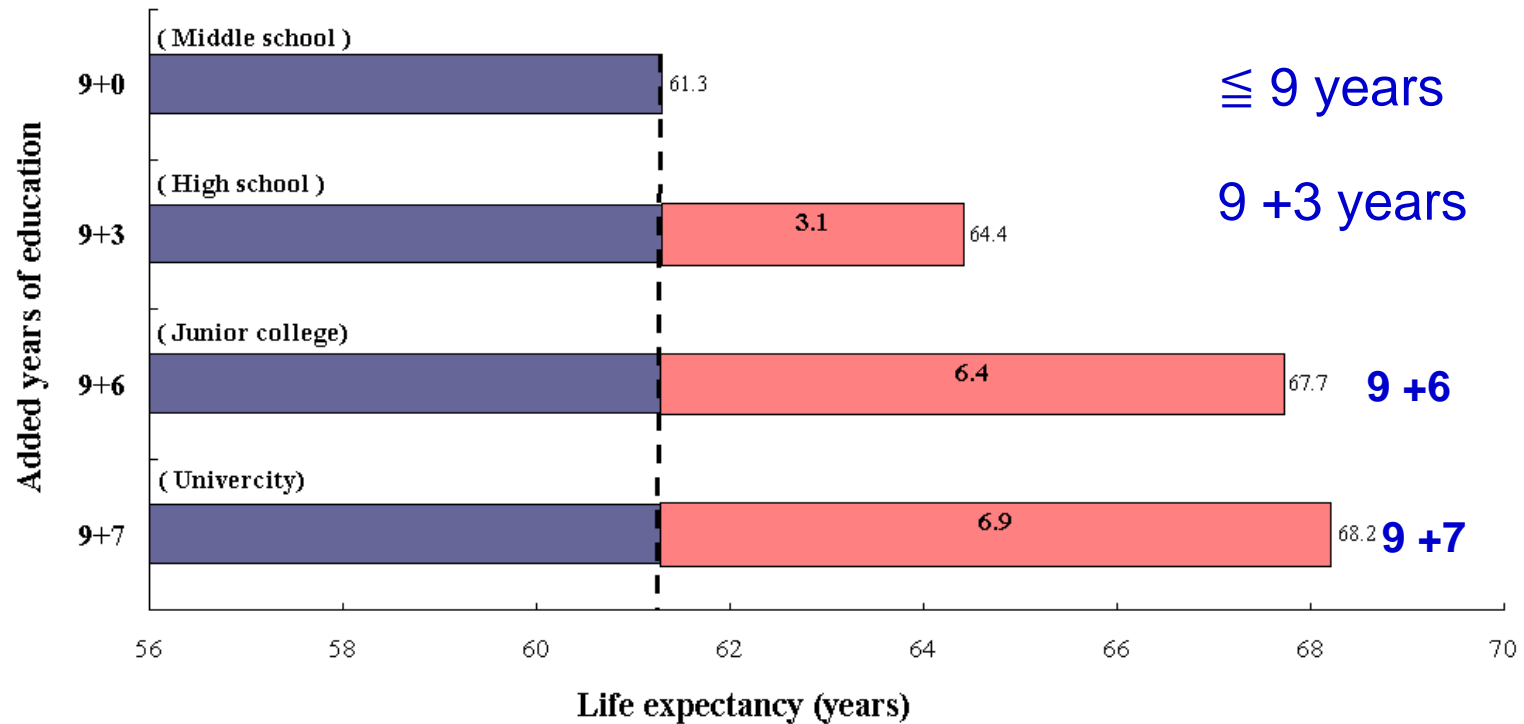
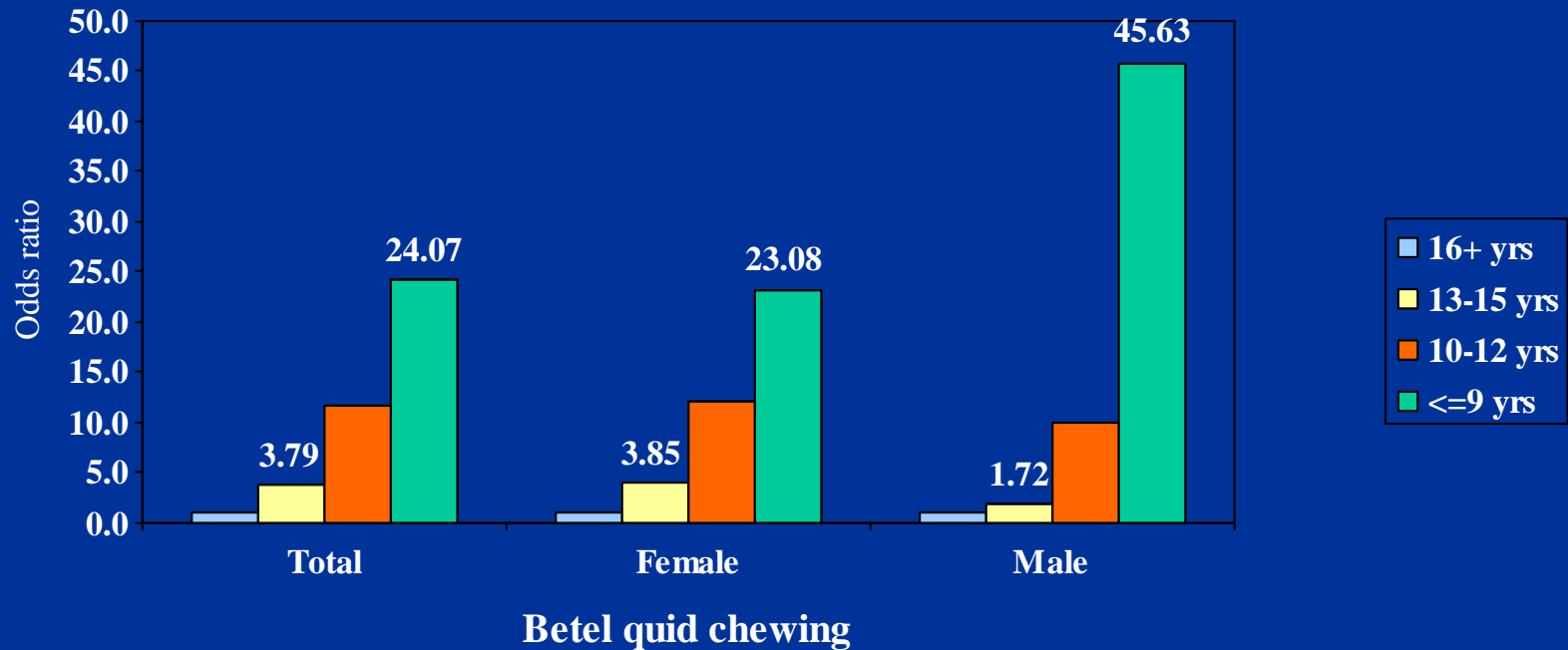# Overall mortality by education

Adjust for age and sex

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- **Education**: The more education, the lower the mortality and the longer the life span

- Almost one to one relationship

- **Association** is observed, but what is the causal relationship?

- Education is associated with different background risks:

- Life style risks:

  - Cigarette smoking – current, non-smoking

  - Betel quid chewing – current, never chewers

  - Alcohol drinking – current, never drinkers

  - Physical inactivity – exercise < 1 hour per week

Comparison of lifestyle risk factors
by educational levels

Highest education $\geqq$ 16 years as reference

	$\geqq$16 years	15 years	12 years	$\leqq$ 9 years
Smoking	1	1.86	3.16	3.28
Physical inactivity	1	1.21	1.35	2.22
Drinking	1	1.58	2.10	2.86

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- **Life style risks**:

  – **Lower education smoked more**

  – **Lower education chewed more betel quid**

  – **Lower education drank more alcohol**

  – **Lower education exercised less, were more inactive**
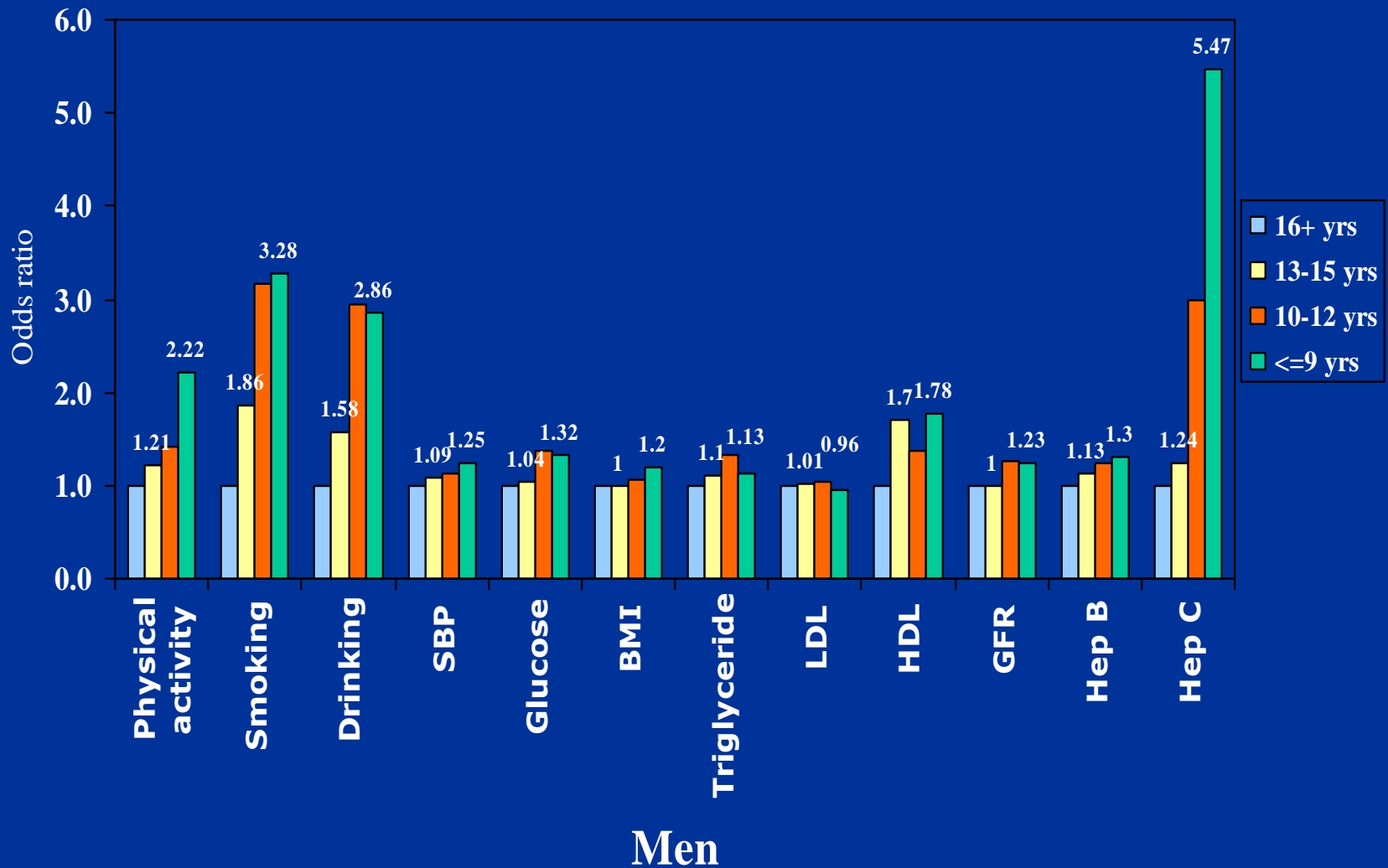
CVD risks

Cardiovascular Disease Risk Factors

- Blood sugar
  - $\geqq$ 126 mg/dL or above)

- Blood pressure
  - $\geqq$ 140 mm Hg Elevated serum triglycerides (200 mg/dL or above)

- Obesity
  - BMI$\geqq$ 25kg/ m^2

- Kidney function
  - GFR$\leqq$ 60 ml/min per 1.73 m^2

Liver Cancer Risk Factors

- HBV: Carrier state of hepatitis B (HBsAg)

- HCV: Carrier state of hepatitis C (Anti-HCV)

- AST: Aspartate aminotransferase (AST 25 U/L or above)

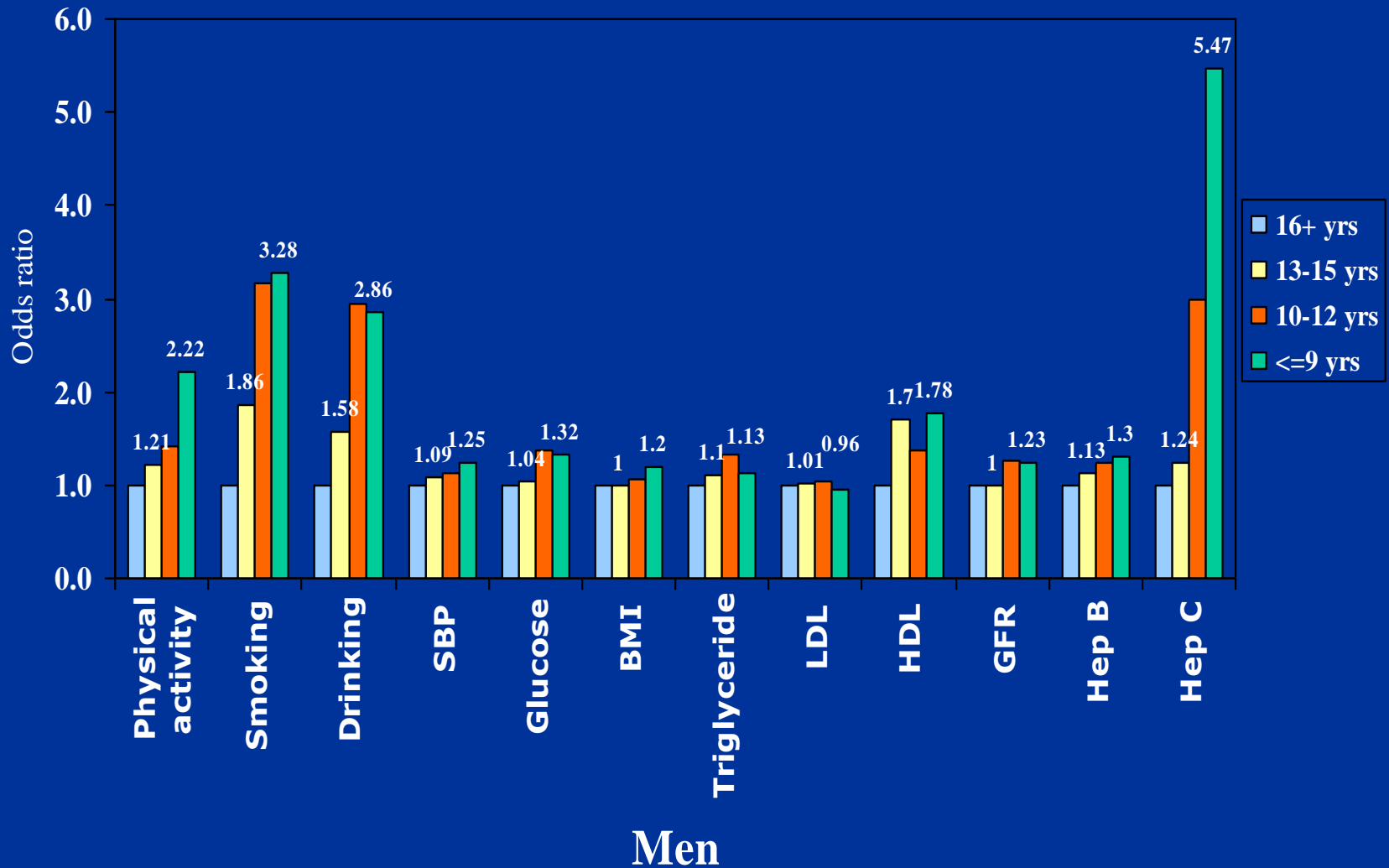- ALT: Alanine aminotransferase (ALT 25 U/L or above)

Comparison of lifestyle and health risk factors by educational levels

Comparison of lifestyle and health risk factors by educational levels

Highest education ≧ 16 years as reference

Odds ratio

6.0
5.0
4.0
3.0
2.0
1.0
0.0

Legend:
- 16+ yrs
- 13-15 yrs
- 10-12 yrs
- <=9 yrs

Physical activity: 1.21, 2.22
Smoking: 1.86, 3.28
Drinking: 1.58, 2.86
SBP: 1.09, 1.25
Glucose: 1.04, 1.32
BMI: 1, 1.2
Triglyceride: 1.1, 1.13
LDL: 1.01, 0.96
HDL: 1.7, 1.78
GFR: 1, 1.23
Hep B: 1.13, 1.3
Hep C: 1.24, 5.47

Men

Characteristics of the cohort

Variables	Middle School <= 9 yrs 107,870	High School 12 yrs 96,334	Junior college 15 yrs 86,342	University >= 16 yrs 109,273
Total cohort: 399,819	**27.0%**	**24.1%**	**21.6%**	**27.3%**
Males	36.5%	45.9%	51.5%	57.8%
Female	63.5%	54.2%	48.5%	42.3%
Physical activity meet recommendation	19.6%	24.4%	27.4%	31.2%
Current smokers	22.1%	31.1%	24.2%	17.9%
Betel quid chewers	9.3%	10.6%	4.9%	1.4%
Current drinkers	21.4%	24.4%	16.9%	13.8%
SBP >= 140 (mmHg)	31.3%	10.2%	7.5%	7.1%
Glucose >= 136(mg/dL)	9.4%	3.1%	1.9%	1.8%
BMI >=30 (kg/m²)	5.7%	3.5%	3.0%	2.7%
Triglyceridemia >=200mg/dl)	15.1%	10.5%	8.8%	8.5%
LDL >= 160 (mg/dL)	17.0%	9.6%	7.8%	7.7%
HDL <35 (mg/dL)	15.2%	16.1%	18.5%	20.0%
Reduced GFR <60 (ml/min/1.73m²)	12.4%	3.4%	2.0%	1.8%
Hep B carrier status	13.3%	16.0%	15.9%	14.5%
Hep C carrier status	9.0%	3.4%	1.3%	1.0%

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- Lower education is associated with more life style risks:

- **Lower education had more health risks or co-morbidities:**

  – Lower education had more **hypertension**

  – Lower education had more **diabetes**

  – Lower education had more **obesity**

  – Lower education had more **kidney function impaired**

  – Lower education had more **hepatitis B and C carrier**

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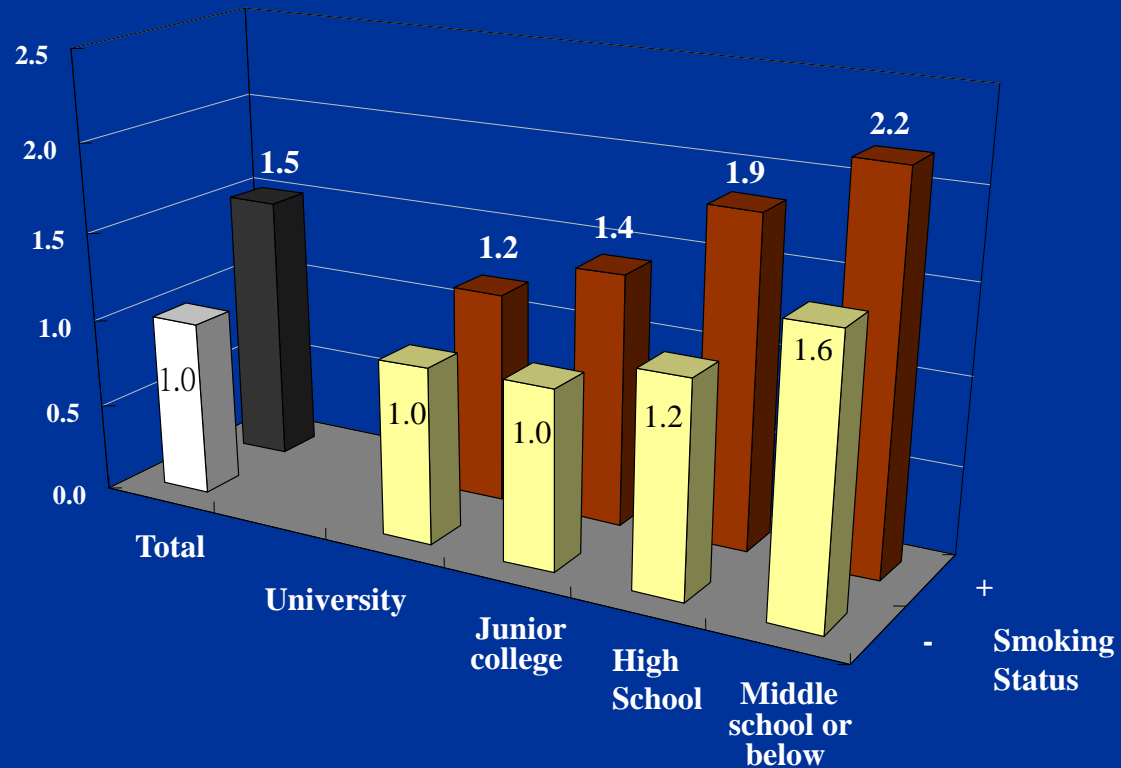
Mortality Risk of CVD Risk Factors
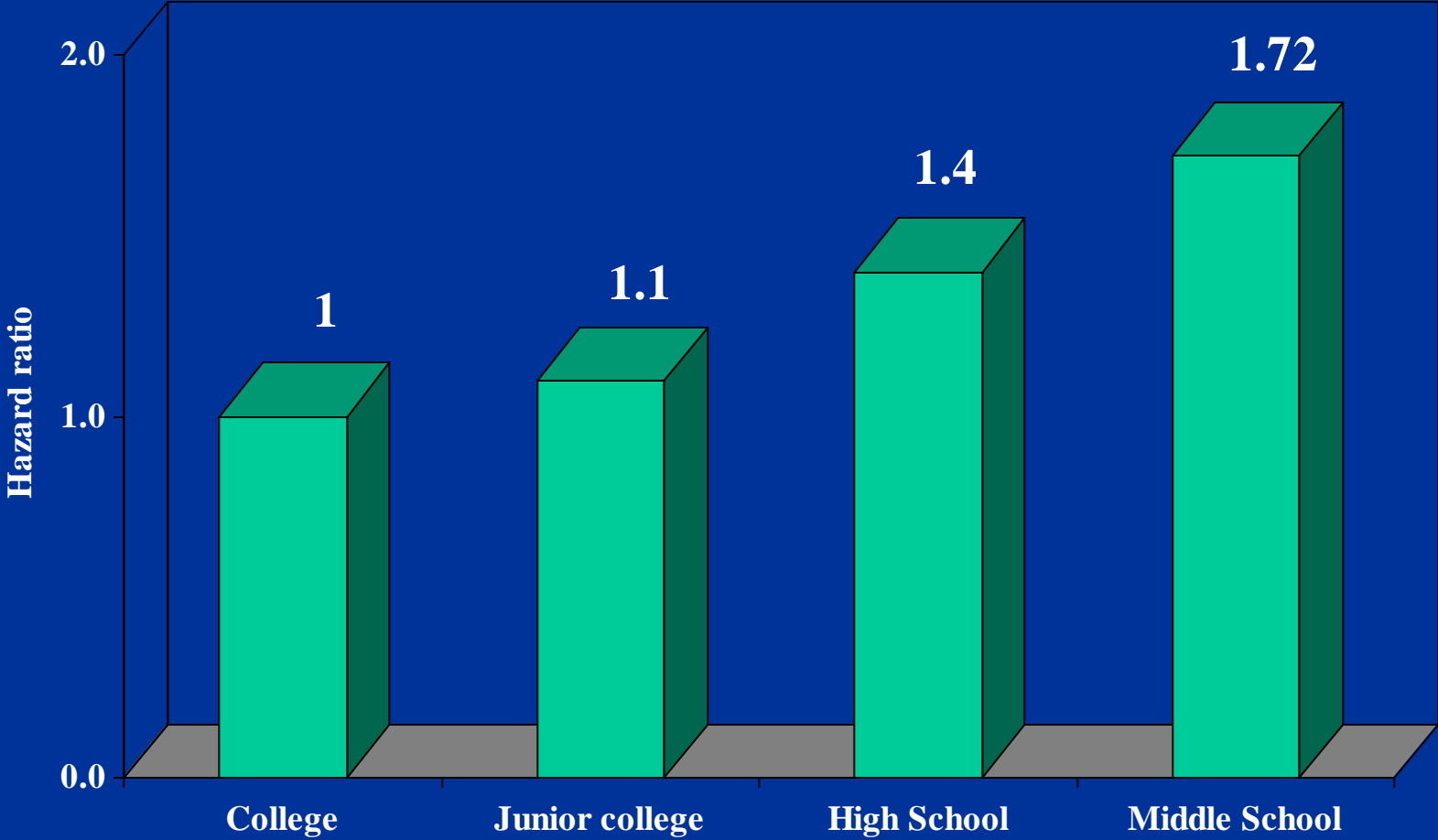
when SES is different
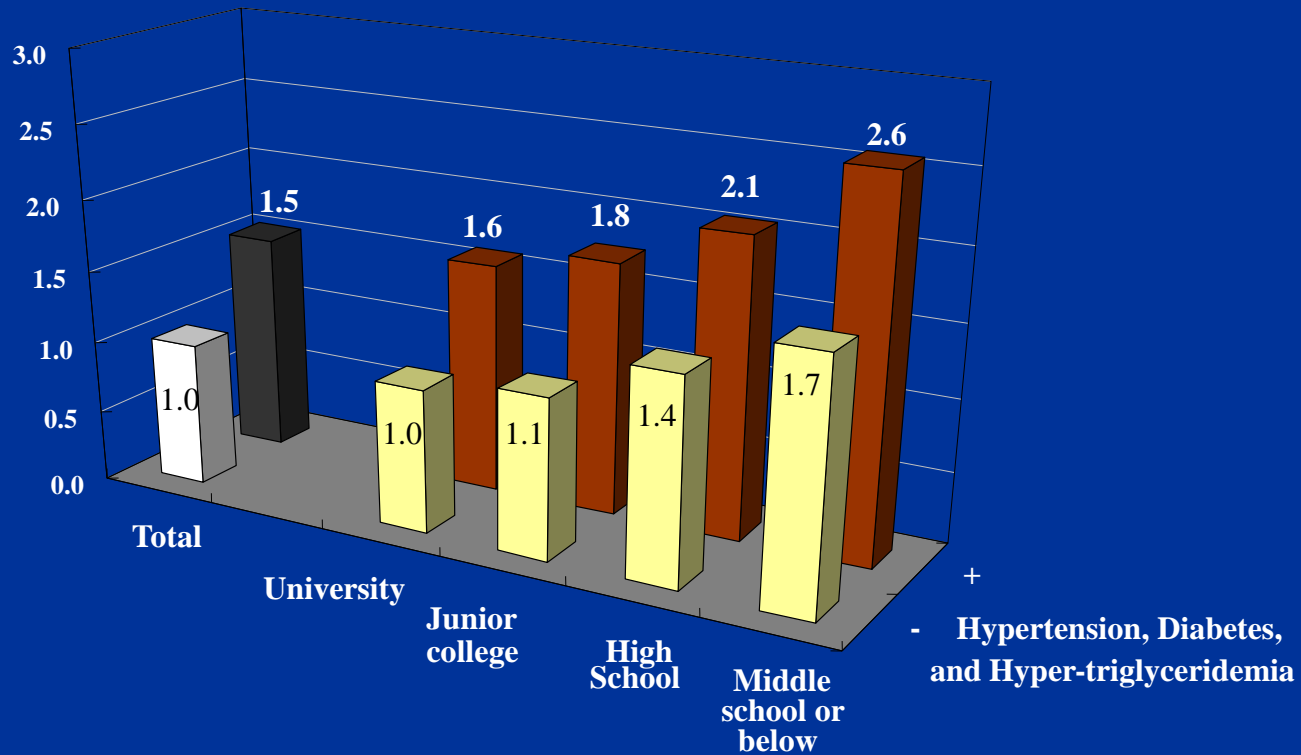
Mortality Risk of Obesity
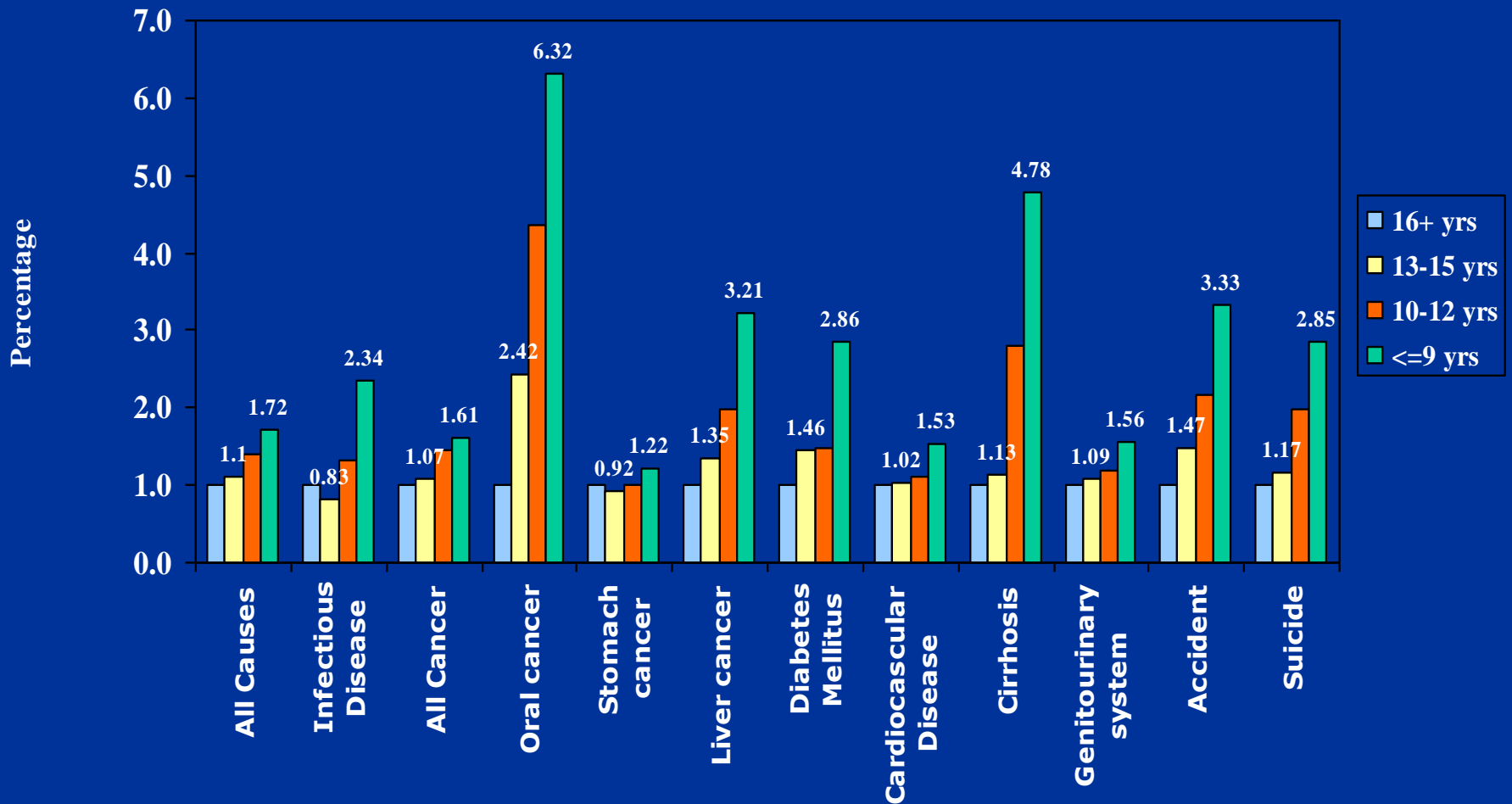
when SES is different
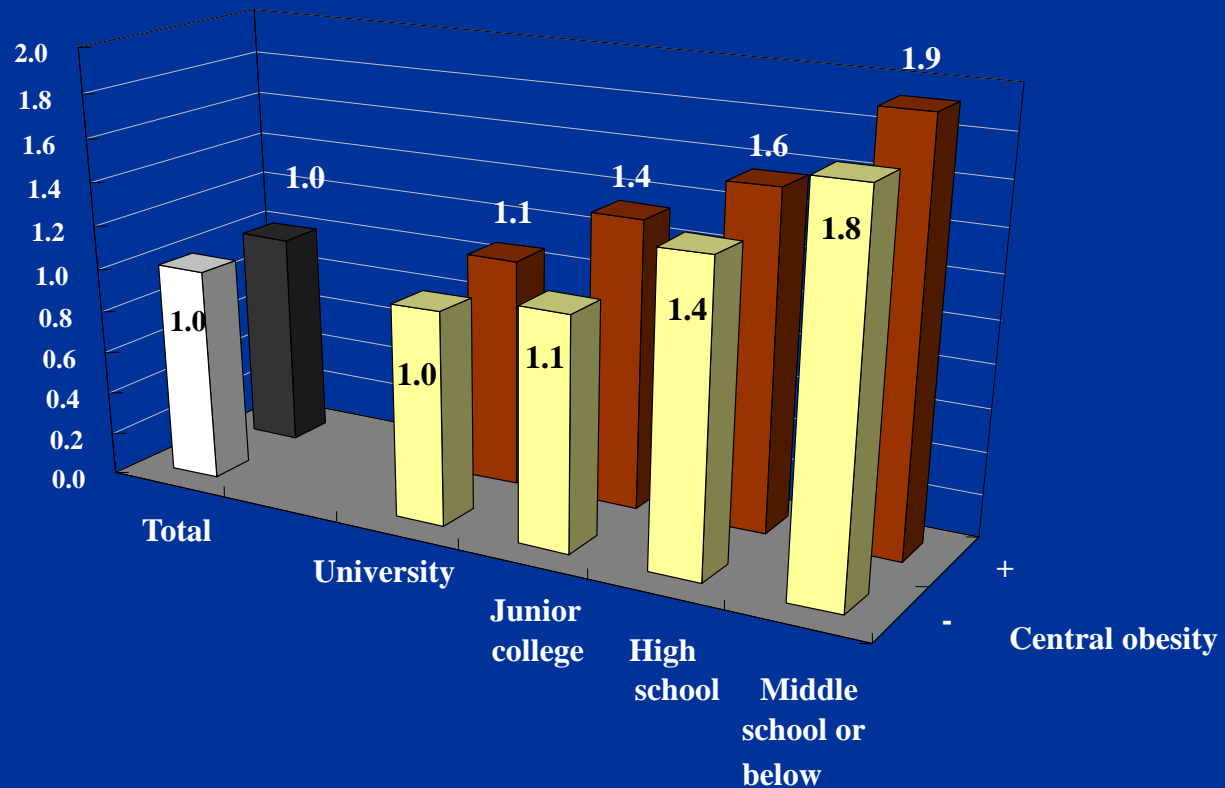
Overall mortality by education

Adjust for age and sex

Hazard ratio adjusted for age and sex by educational levels

Different causes of death by different SES

Contribution of specific cause to mortality gap middle school vs university

Causes of death	University Rate 1	Junior college Rate 2	High school Rate 3	Middle school Rate 4	Mortality Rate 4- Rate 1	% of Total
All causes	230.0	263.0	314.0	408.6	178.4	**100%**
Infectious Disease	2.3	2.7	3.5	7.2	4.9	**3%**
All cancer	73.8	91.6	125.2	145.5	71.7	**40%**
Liver	*14.6*	*19.8*	*26.6*	*43.3*	*28.7*	**16%**
Lung	*14.9*	*17.9*	*30.6*	*32.0*	*17.1*	**10%**
Diabetes	9.4	10.7	16.1	22.0	12.6	**7%**
CVD	66.1	55.9	56.7	78.8	12.7	**7%**
Respiratory	16.1	24.8	19.2	31.5	15.4	**9%**
Cirrhosis of liver	5.0	5.9	12.3	16.3	11.3	**6%**
Genitourinary	9.3	7.1	7.4	8.5	(0.8)	**---**
Accidents	11.3	16.6	23.7	35.1	23.8	**13%**
Suicide	2.0	4.9	7.2	15.5	13.5	**8%**

Age-standardized mortality rates per 100,000 adjusted to 2000 WHO standard population

- **Causes of The gap:**

- **40% from cancer**

- **14% from CVD and diabetes**

- **13% from accidents**

- **9% from respiratory**

- **22% from liver (cirrhosis and cancer)**

Hazard ratio adjusted for age, gender, smoking, obesity and other cardiovascular risk factors
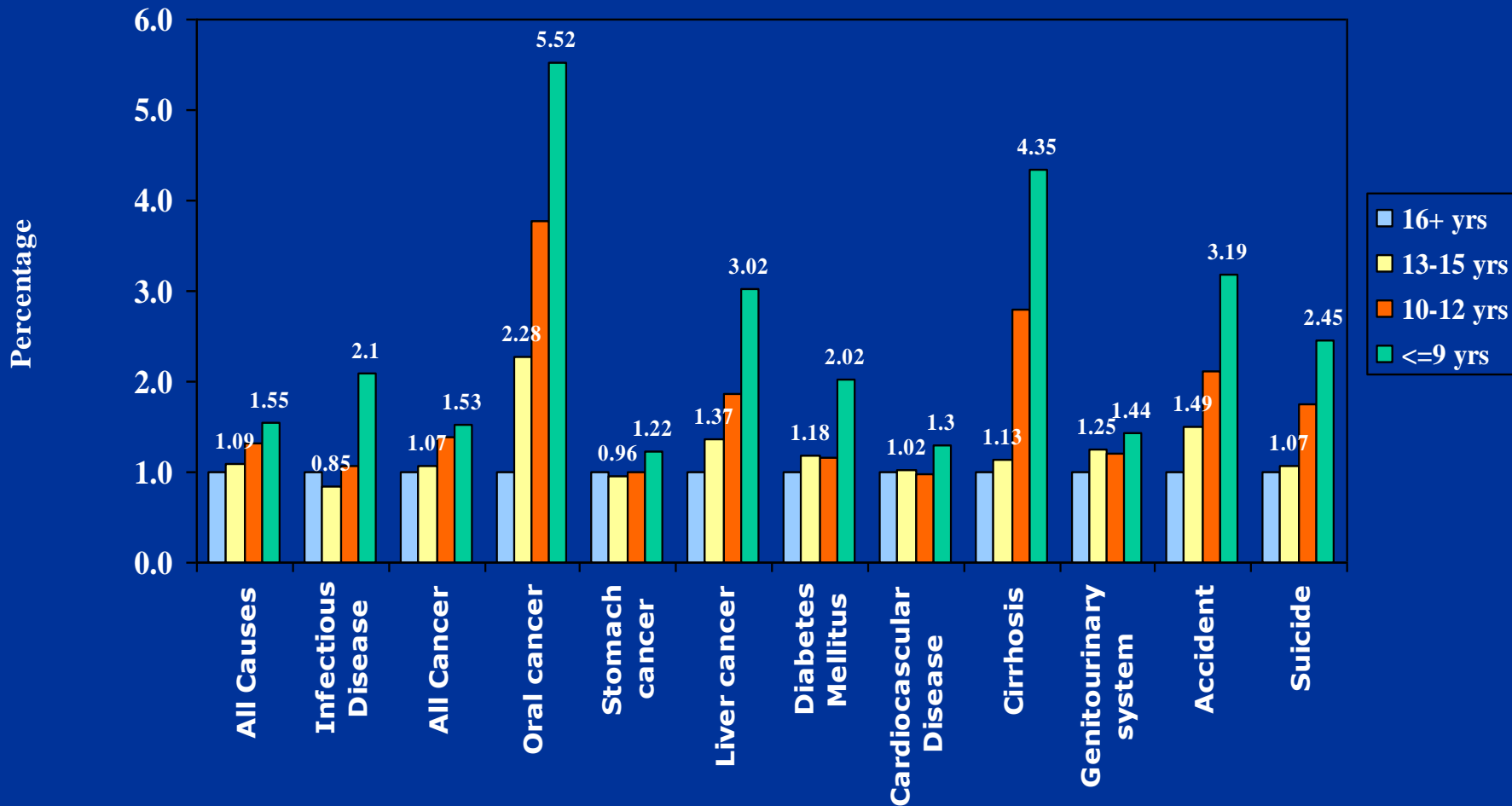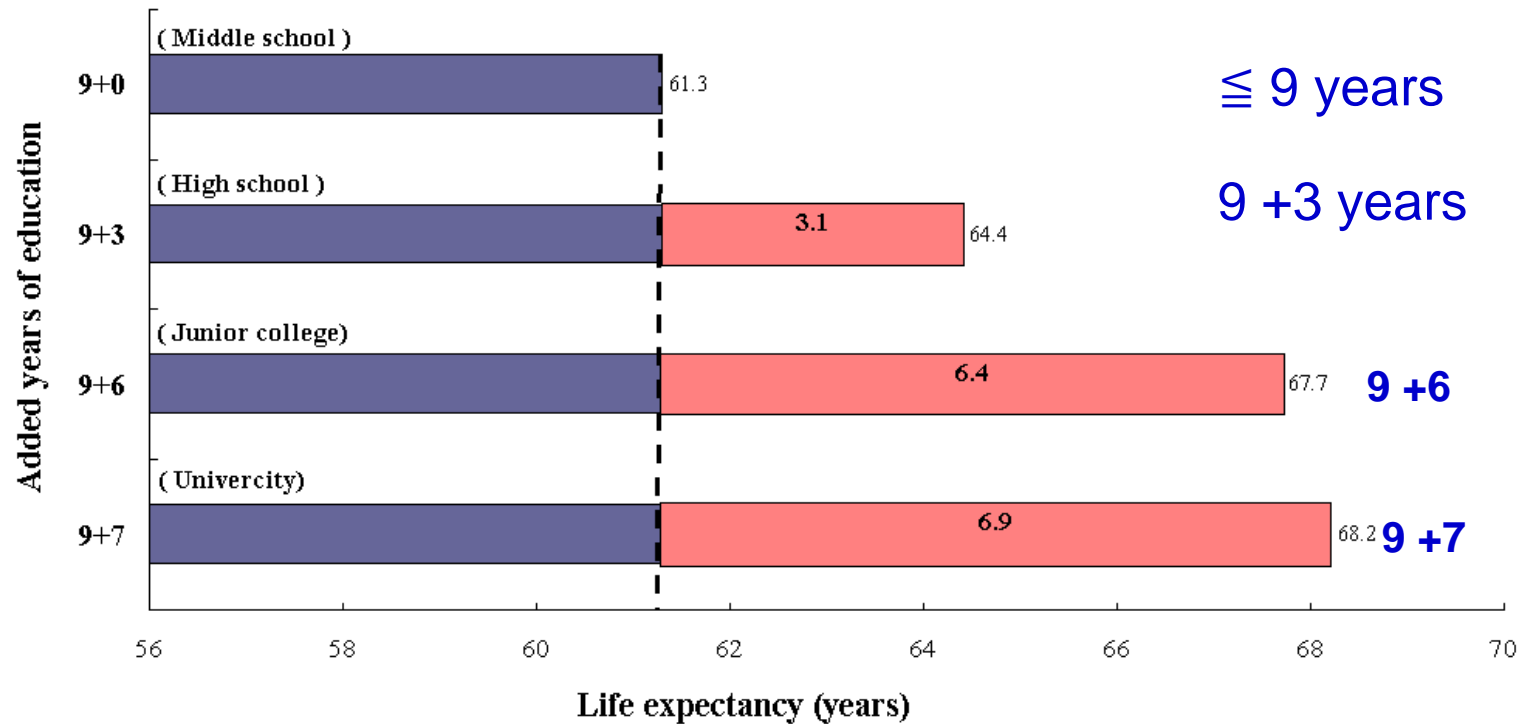
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9 +7

Is the gap narrowing

because of national health insurance?

- Taiwan implemented NHI in 1995

- One overarching goal of NHI is to reduce the health disparity

- We all assume it must have

  – Because poor can have access to medical care that otherwise would not be possible

Comparison of all cause mortality between two time periods
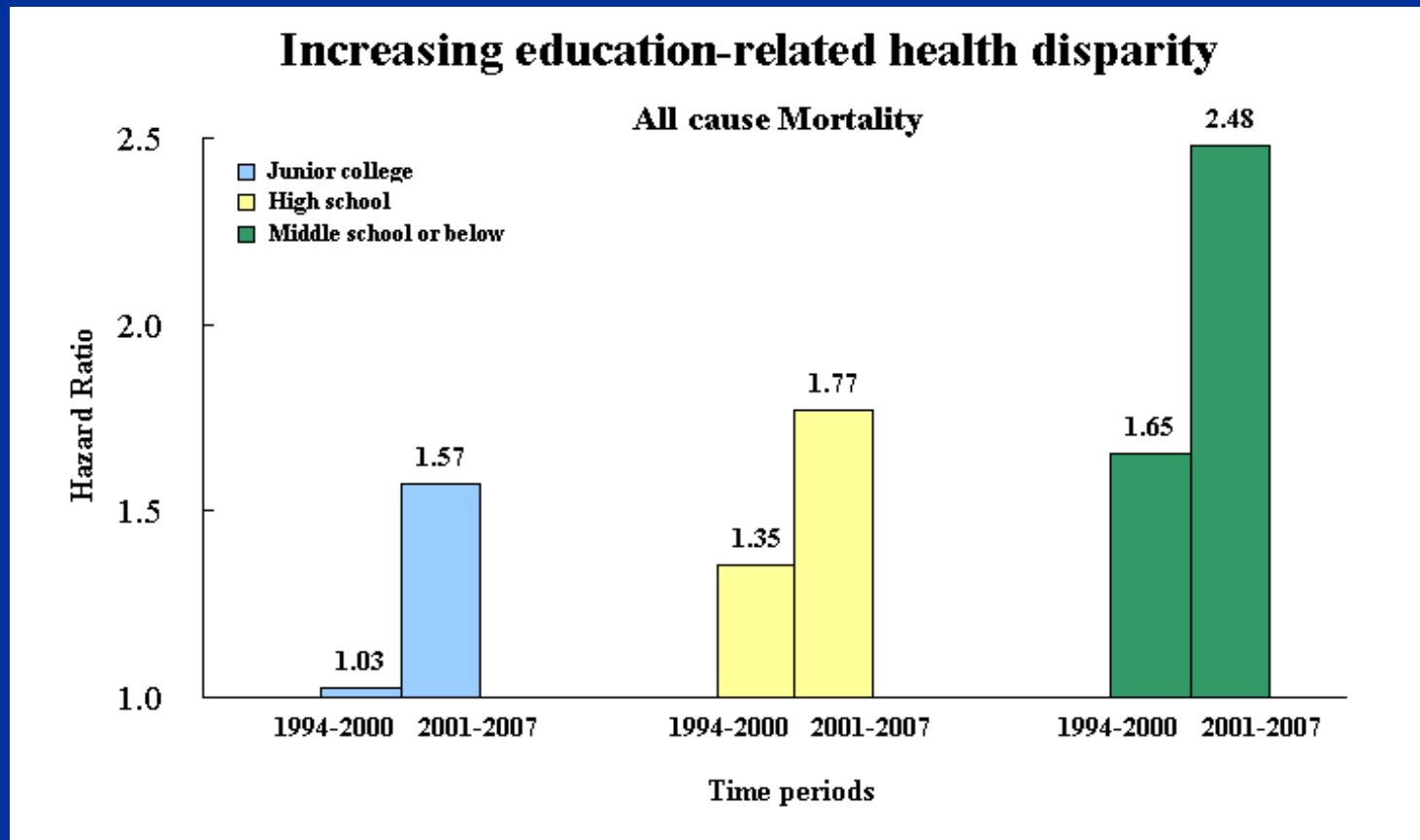
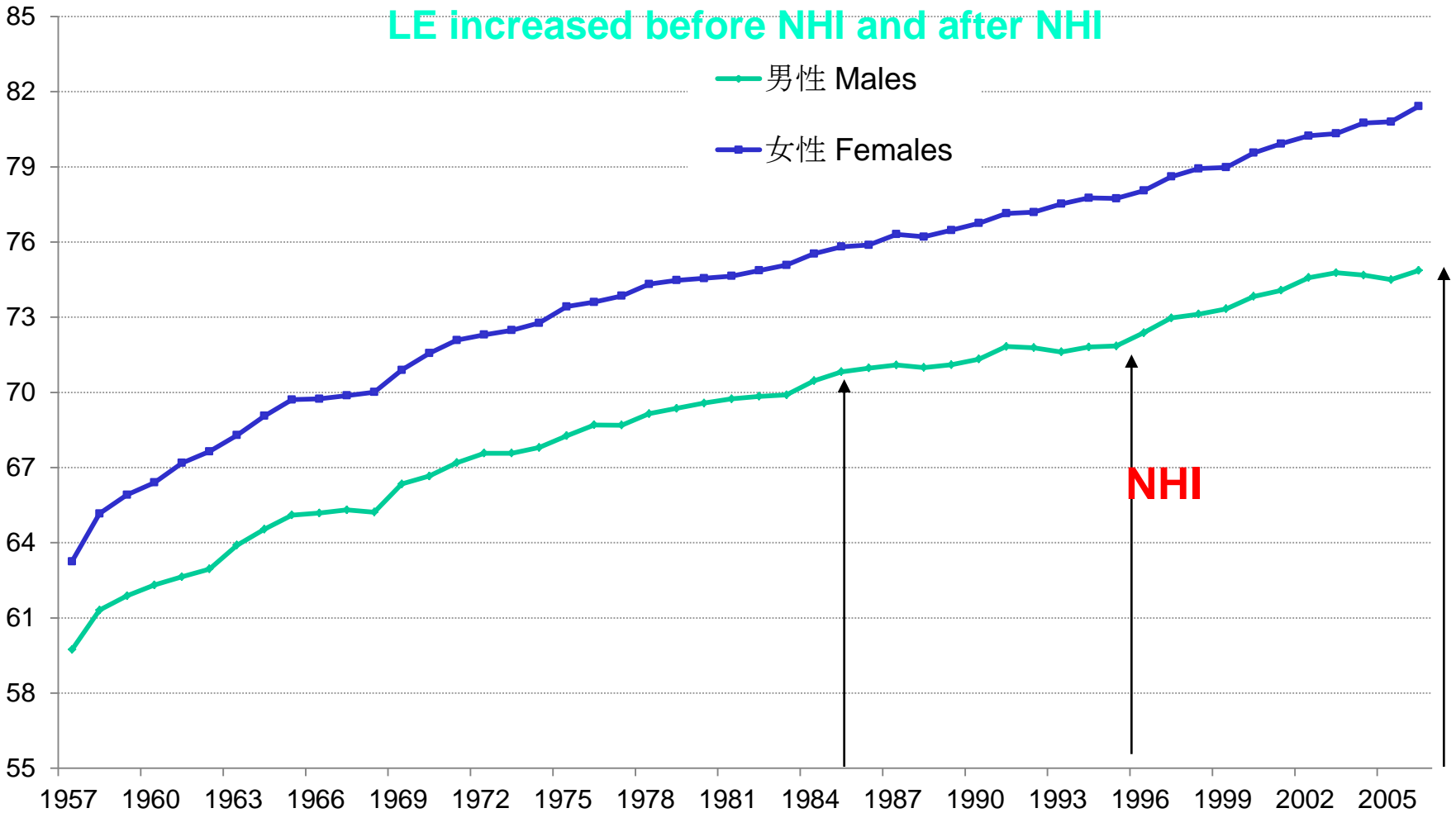# Comparison of all cancer mortality between two time periods
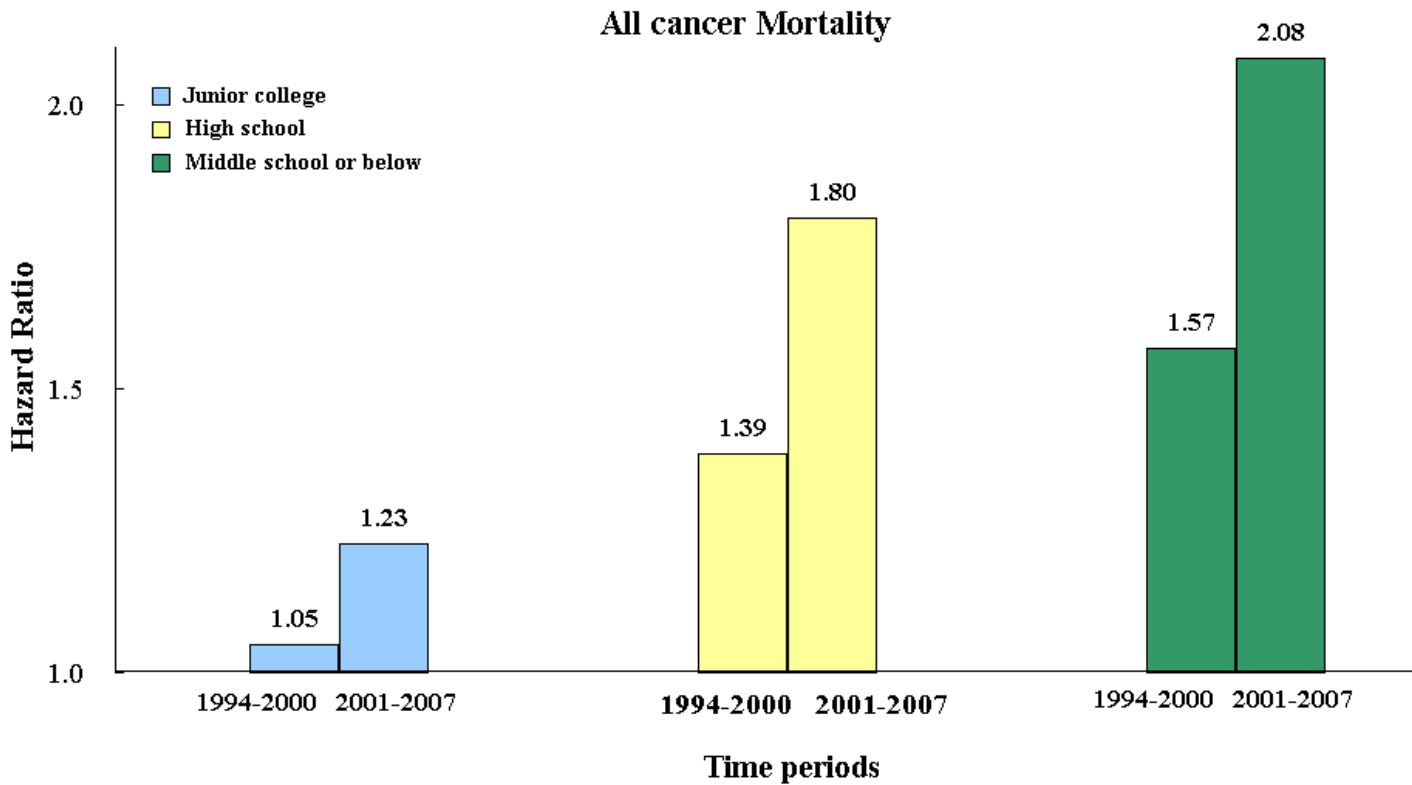
Life Expectance of Taiwan Population

台灣人口之出生時平均餘命(year 年): 1957 - 2006

Life expectancy at age 0 for male in 23 cities/counties
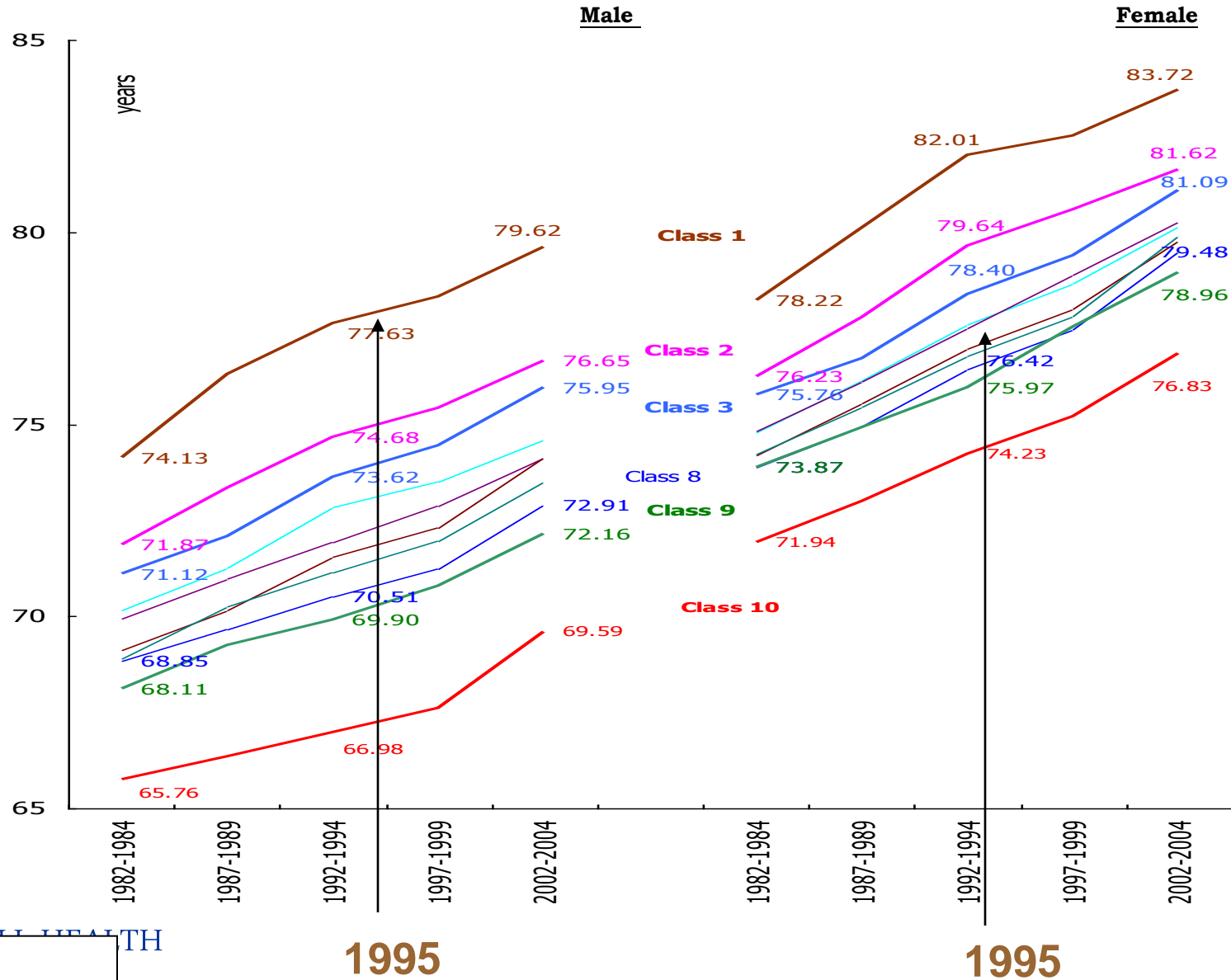各縣市之男性零歲時之平均餘命: 1972-2009

We can do better 我們應能更好

台灣的健康差距比我們想像要大
Disparity is much larger than we thought

Appendix Figure .
Secular trends of life expectancy at birth for the 10 Health Class Groups, 1982-1984 to 2002-2004

健保前　　　　健保後

十年

1982-1984　　**1992-1994**　　**2002-2004**

Net gain

平均餘命的改善

2.27　　　**2.39**

0.12　　　男生

Males　　　69.56　　　71.83　　　74.22

Females　　74.58　　　77.31　　　80.09　　　**0.05**　　女生

2.73　　**2.78**

Before and after NHI
in life expectancy

TH

台灣全民健保的十年經驗

- **Conclusion:** Life expectancy after the introduction of national health insurance improved more for lower-ranked health classes, resulting in narrowed health disparity. The magnitude of the reduced disparity was small compared with the size of the remaining gaps. Relying on universal insurance alone to eliminate health disparity does not seem realistic. To further reduce health disparity, Universal insurance programs should incorporate primary prevention, focusing on lifestyle risk reductions

- 全民健保雖有減少健康貧富差距，但是減少的差距甚小 ，與現存之健康貧富差距相去甚遠。要依賴全民健保，來減少健康貧富差距 是不切實際的。

- 全民健保，要加入改變生活習慣(型態)來減少健康貧富差距 。

- **Annals of Internal Medicine**: 2008
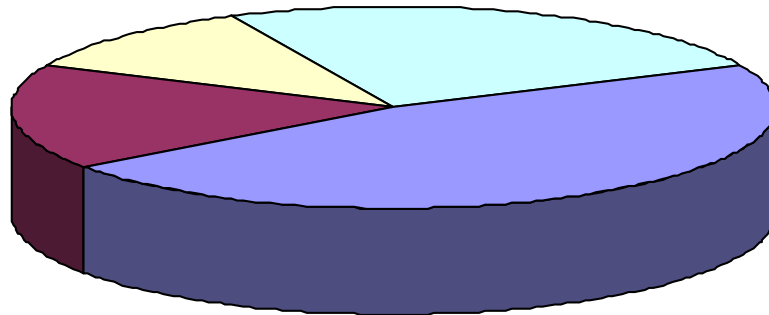 - Impact factor: **17.5**

TH

決定健康的因素

醫療的功效被高估

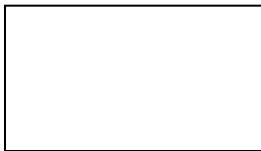**medical care**
醫療
11%

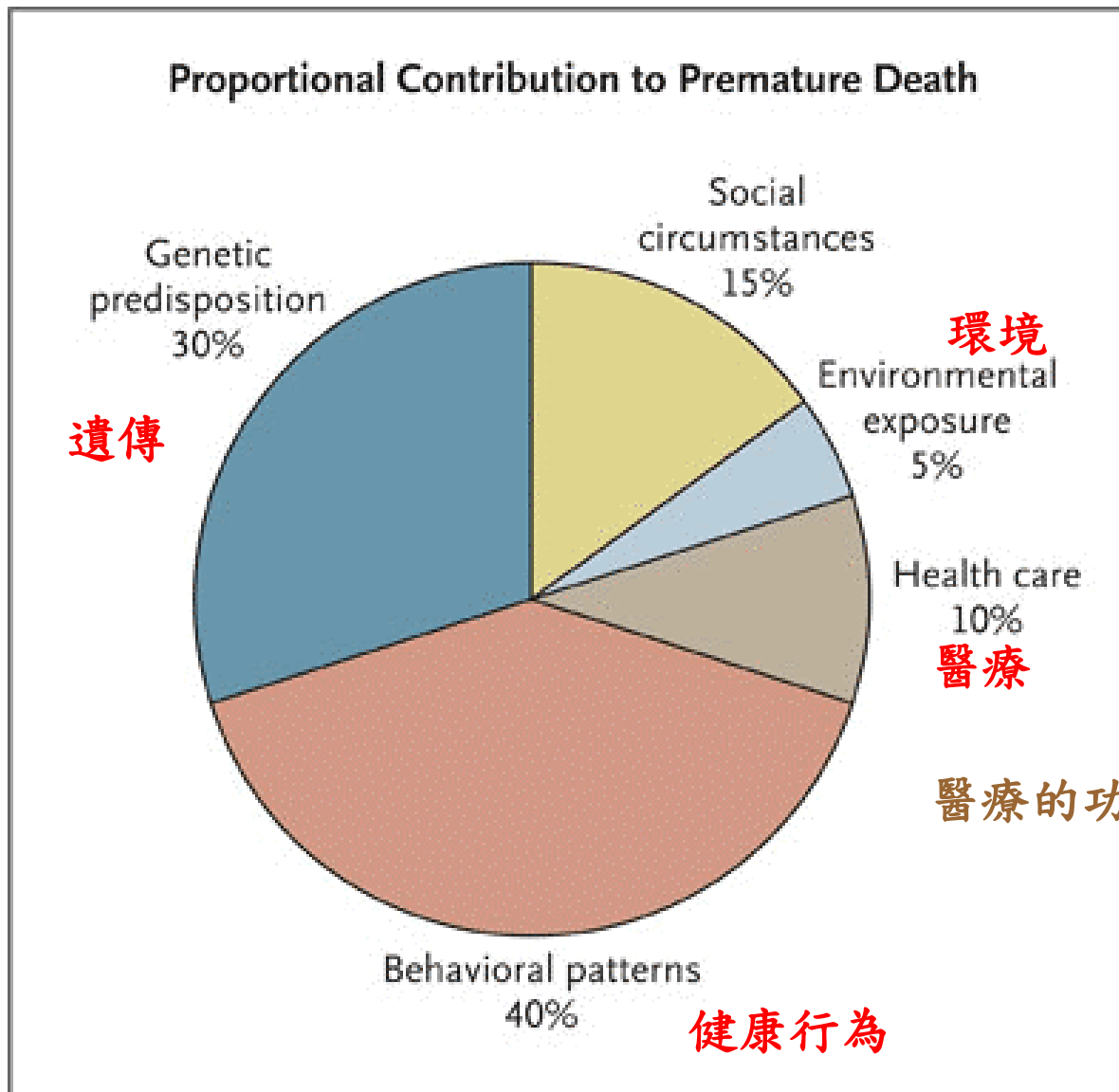human biology
人類遺傳生理因
素
25%

**Environmen
tal risk**
環境因素
17%

**Individual
behavior**
個人生活行為
47%

47%+17%=64%

TH

CDC Healthy People 2000 Midcourse Review, 1995

New England Journal of Medicine 決定不健康死亡的因子

Proportional Contribution to Premature Death

Social circumstances 15%

環境

Environmental exposure 5%

Genetic predisposition 30%

遺傳

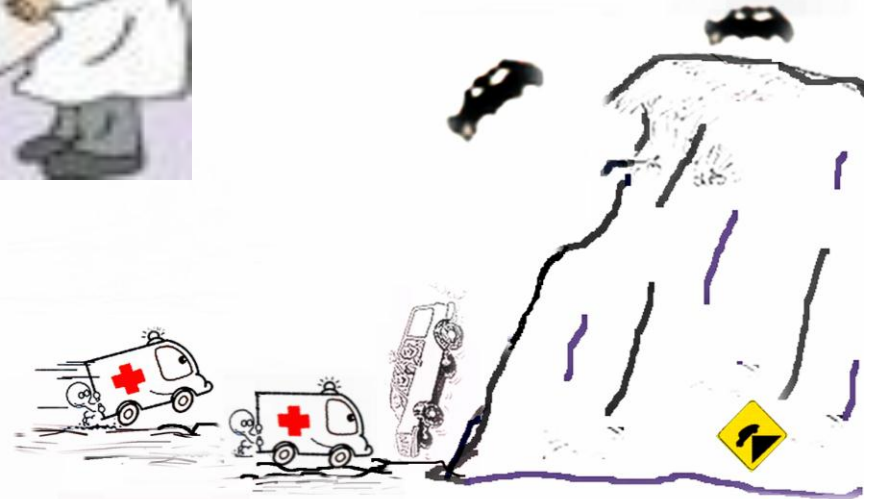Health care 10%

醫療

醫療的功效被高估

Behavioral patterns 40%

健康行為
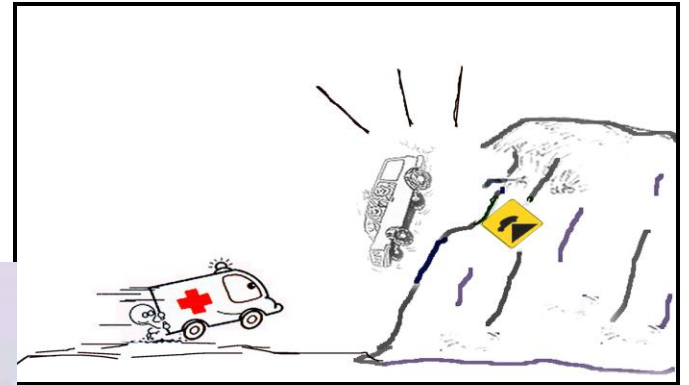
Medical care is fire fighting

- 懸崖上有險峻之彎道,柵欄年久失修,小轎車一不小心就會衝過柵欄摔落山下

- 山下數部救護車忙於後送傷者前往醫院急診處
  - ,聘請國外骨科專家駐院指揮,提供世界級的醫療服務
    為方便處理傷患,在山谷底下蓋了一座大型醫院,
    等待更多傷者提供急救

Conclusions - 1

- Each additional year in education after middle school was associated with one year increase in life expectancy

- The large health disparity gaps have not reduced after the introduction of National Health Insurance

- Low educated groups have higher prevalence of lifestyle habits and health risk factors in both men and women

- Lower educated groups have higher overall mortality, even after adjusted for lifestyle and health risk factors

Conclusions - 2

- Cancer gap in lower educated group was largely responsible for the educational disparity (40% of the gap), contrary to most Western countries where CVD was the leading cause

- Higher smoking rate and chewing rate among the lower educated subjects have contributed to their higher cancer rate

- Excess cancer risk among people in the lowest education could be reduced by 38%, if smoking were reduced to the levels of their highest counterparts

人類最高的成就是減少健康不公

- Reducing inequity in health is the highest human achievement

  » **Bill Gates**

Commencement speech at Harvard
前年六月哈佛大學
畢業典禮

TH

Let us work together
to reduce the health disparity

Thank You