COMPRESSION OF MORBIDITY: NEW INSIGHTS IN THE ROLE OF LIFESTYLE FACTORS

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50
40
60
70
80
90
100
10
20
30
Gedenckt te Sterven

FRIES JF. 'Aging, natural death, and the compression of morbidity'. NEJM 1981

- **Syllogism:**

  - the human life span is fixed (and average life expectancy is rapidly approaching this limit)

  - the age at first infirmity will increase

  - therefore, the average duration of infirmity will decrease

FRIES (2)

- Average life expectancy is rapidly approaching its biological limit:

  - increases in life expectancy reflect mortality declines at younger ages: rectangularization of survival curves

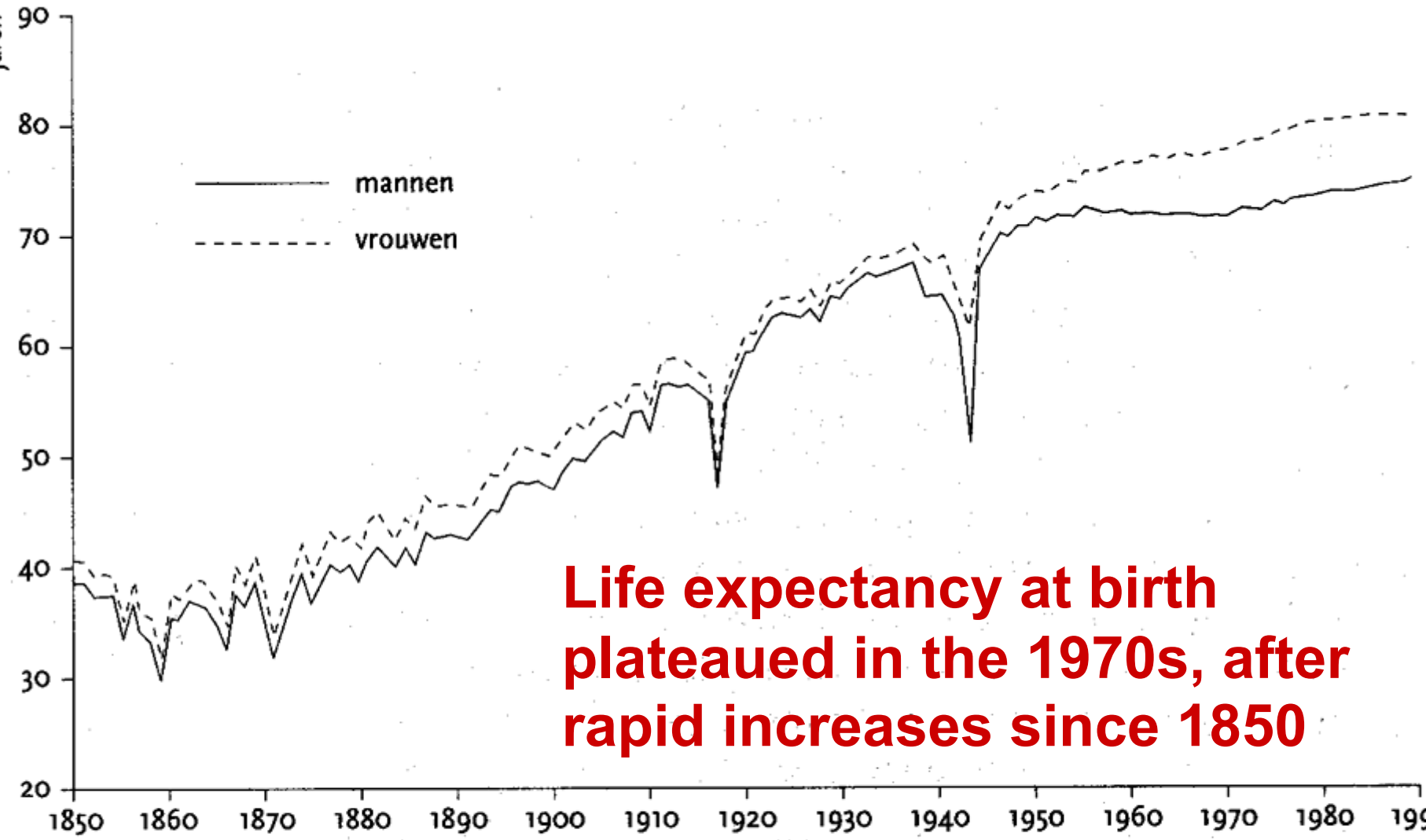
  - further rectangularization is likely to occur, around mean age at death of 85 years

FRIES (3)

- Age at first infirmity will increase:

  - frequency of some chronic illnesses is already declining (e.g. cardiovascular)

  - further reduction is possible and likely to occur as a result of lifestyle improvement



Figuur 2-1 Ontwikkeling van de gemiddelde levensverwachting bij de geboorte (in jaren) tussen 1850 en 1990.

Bron: Poppel FWA, van. Trends and sex differentials in Dutch mortality since 1850. Genus 1996;52:107-134.

OMRAN AR. The epidemiologic transition. Milbank Mem F Q 1971

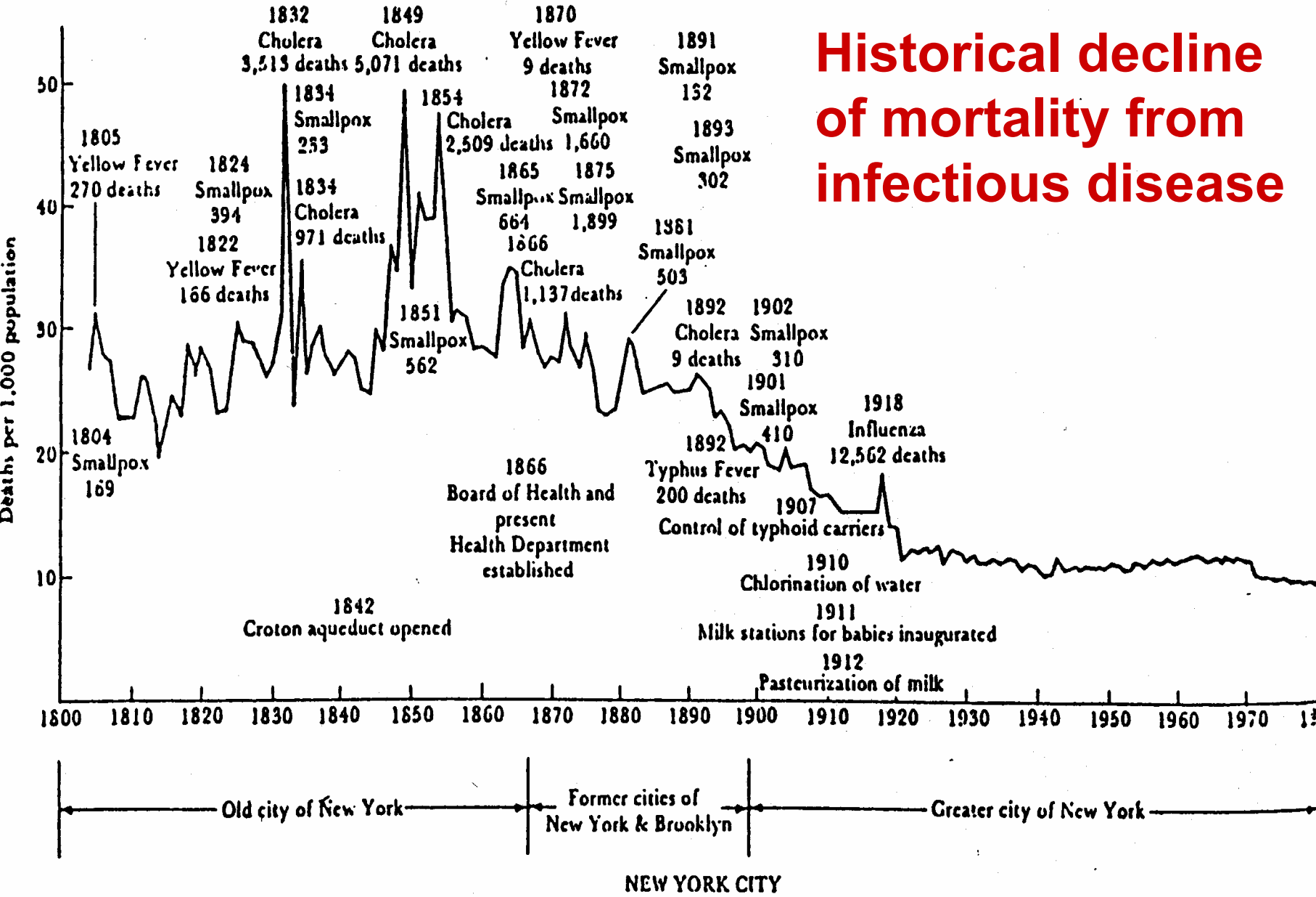
- Pandemics of infection are gradually displaced by degenerative and man-made diseases, in three stages:

  - age of pestilence and famine

  - age of receding pandemics

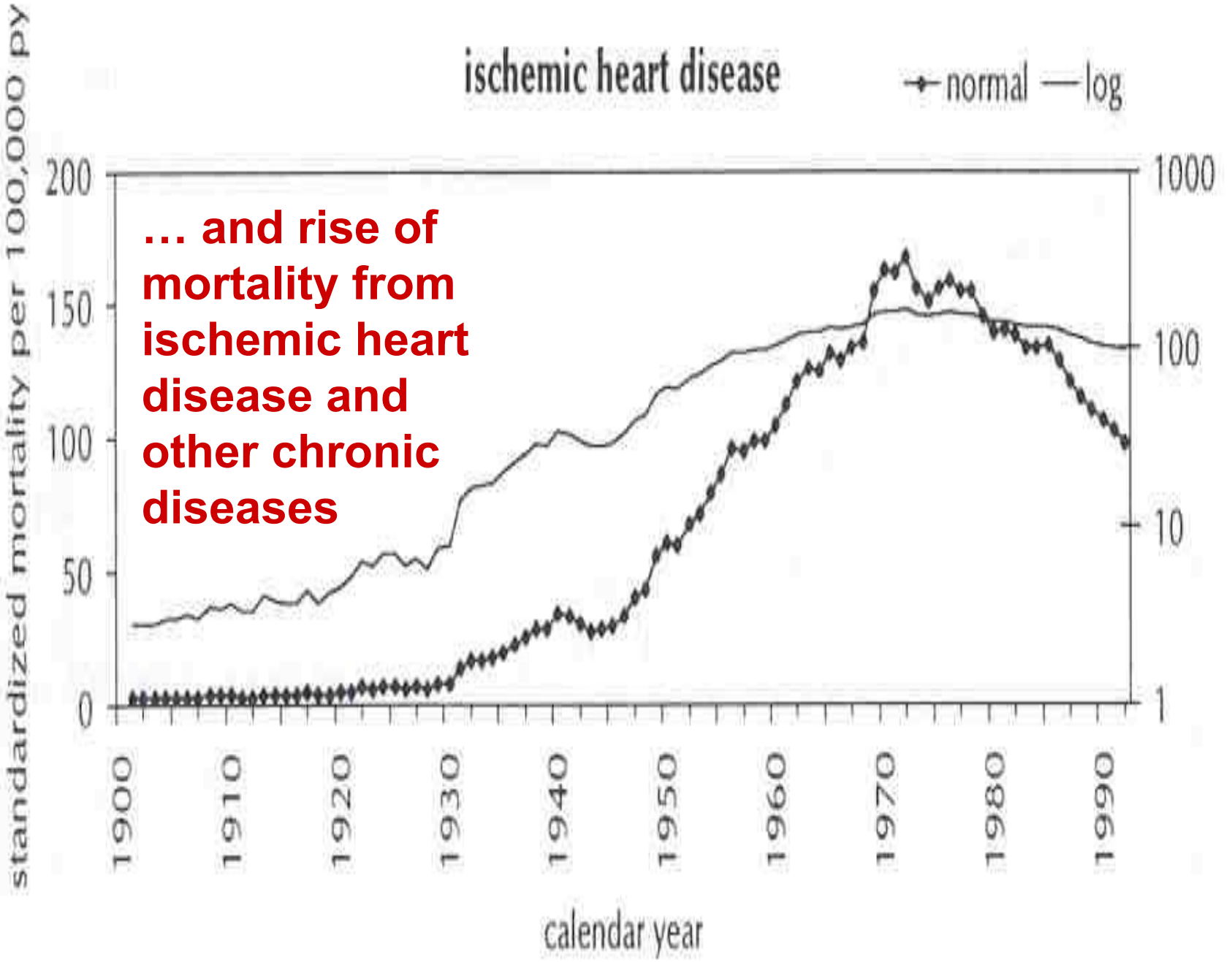
  - age of degenerative and man-made diseases

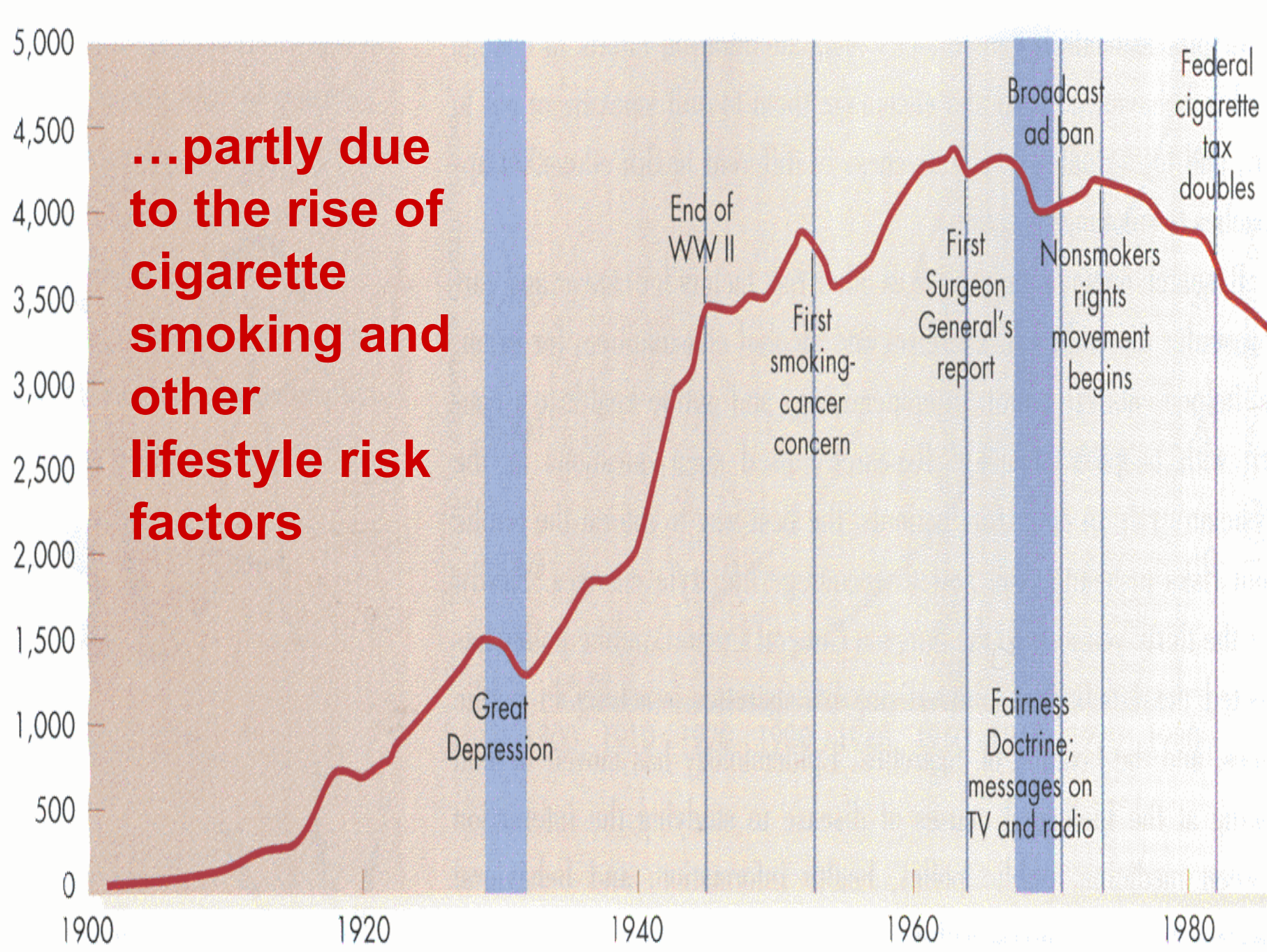
Historical decline of mortality from infectious disease



Source: New York City, n.d.; updated by the author.

FIG. 1a — Mortality transition in New York City


ischemic heart disease
normal
log
standardized mortality per 100,000 py
200
150
100
50
0
1000
100
10
1
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
calendar year
… and rise of mortality from ischemic heart disease and other chronic diseases


…partly due to the rise of cigarette smoking and other lifestyle risk factors
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1900
1920
1940
1960
1980
Great Depression
End of WW II
First smoking-cancer concern
First Surgeon General's report
Fairness Doctrine; messages on TV and radio
Broadcast ad ban
Nonsmokers rights movement begins
Federal cigarette tax doubles

UNANSWERED QUESTIONS

- Was the epidemiologic transition accompanied historically by an expansion of morbidity (cf. Myers' 'disability transitions')?
- If so, did higher exposure to modern lifestyle factors historically contribute to an expansion of morbidity?
- Will reduced exposure to modern lifestyle factors contribute to a compression of morbidity in the future?

OUTLINE OF PRESENTATION

- Conceptual and empirical progress since Fries' 1981 paper
- Results Dutch research programme on compression of morbidity
- Conclusions, and implications for research and public health policy

CONCEPTUAL AND EMPIRICAL PROGRESS

- The ‘remarkable plasticity of human longevity’: rapid declines of mortality among the elderly
- Distinction between ‘morbidity’, ‘functional ability’, ‘disability’, ‘health care use’, …
- New methods for quantification of compression: Sullivan, multistate, ….
- Morbidity and mortality do not change independently

DUTCH RESEARCH PROGRAMME COMPRESSION OF MORBIDITY

- Collaboration between Erasmus MC and Groningen University
- Funded by Netherlands Organization for Scientific Research
- 3 PhD theses (Mamun, Janssen, Franco Duran), 30 papers in international scientific journals

COMPREHENSIVE ANALYSIS DATA AND METHODS (1)

- Framingham Heart Study, individuals aged 50 and older
- 3 non-overlapping 12 year follow-up periods starting 1956-58, 1969-73, and 1985-89
- Self-reported smoking, time spent on physical activity; measured weight and blood pressure
- Physician evaluated cardiovascular disease; death
- 9304 observation intervals used in analysis

COMPREHENSIVE ANALYSIS DATA AND METHODS (2)

- Pooling of Repeated Observations method
- Poisson regression, Hazard Ratios for 3 transitions (no CVD to CVD, no CVD to Death, CVD to Death)
- Confounders selected according to variable of interest (age, sex, education, marital status, comorbidity), start of follow-up period, other cardiovascular risk factors)
- STATA version 8.2

COMPREHENSIVE ANALYSIS DATA AND METHODS (3)

- Period multistate life tables, starting at age 50 and closed at age 100, by gender
- 3 states (free from CVD, history of CVD, death), no backflows
- By level of exposure to risk factor, transition rates as estimated in Poisson regression
- Confidence intervals estimated by parametric bootstrapping with @RISK

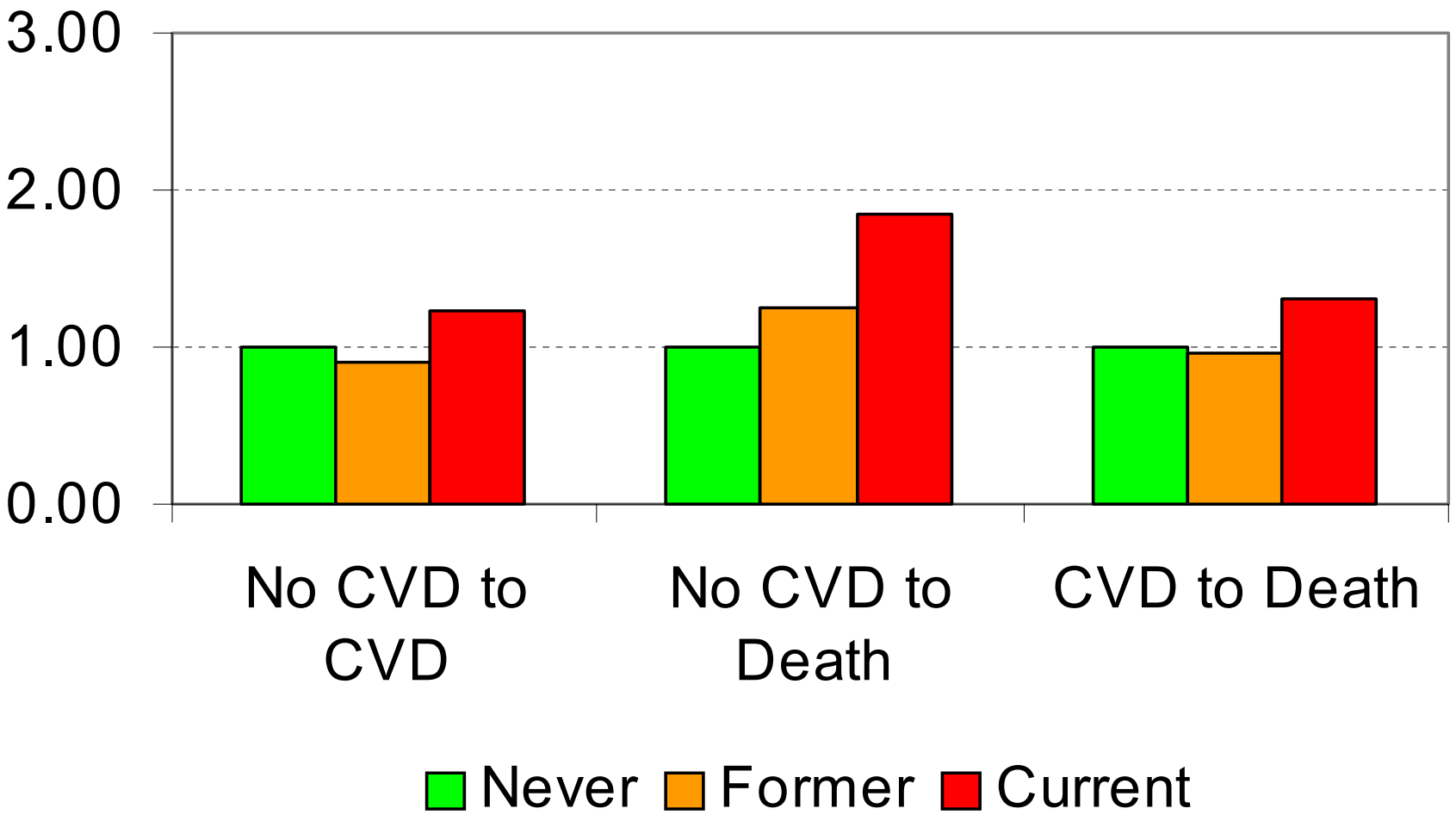
COMPREHENSIVE ANALYSIS SUMMARY OF RESULTS

- Smoking and lack of physical activity increase all 3 transition rates
  -- therefore are neutral w.r.t. compression

- Hypertension and obesity primarily increase incidence rates
  -- therefore lead to expansion of morbidity

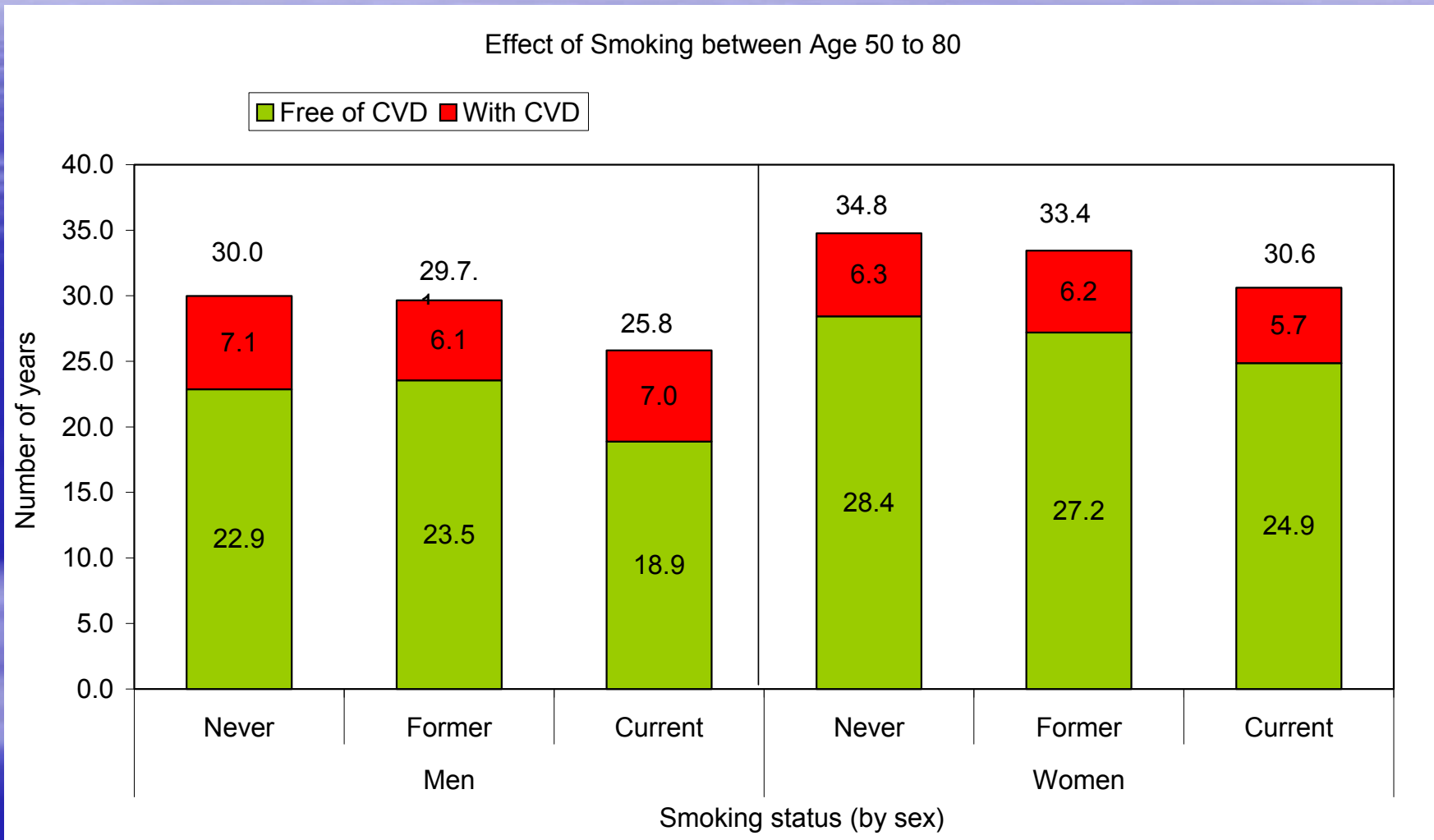
- In the right mix, prevention of these risk factors may produce compression of (cardiovascular) morbidity

Smoking
Rate Ratios for 3 transitions



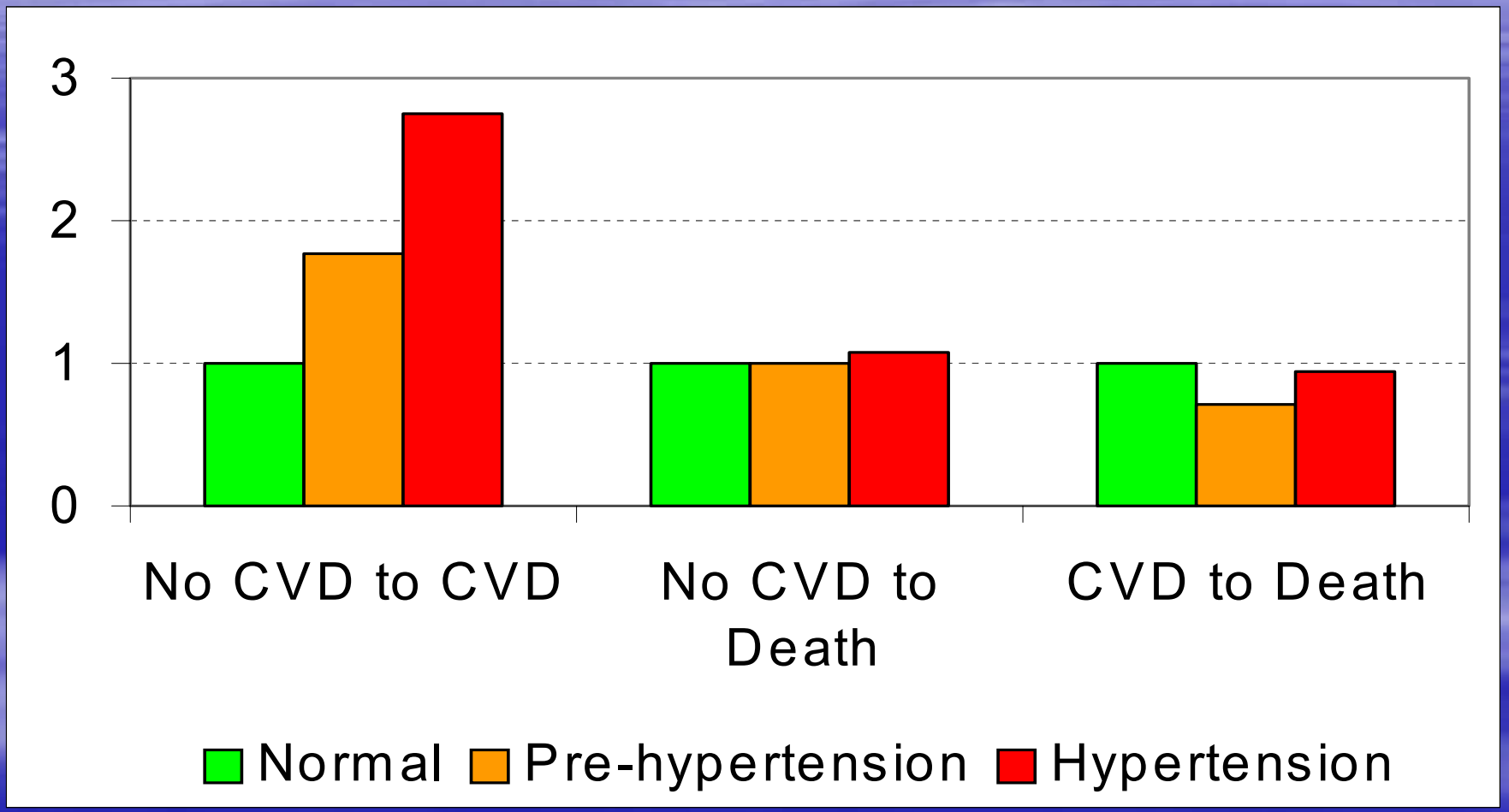
Corrected for age, sex, hypertension, BMI, physical activity, co(morbidity), start follow-up. Source: Our analyses of the Framingham Heart Study

Smoking
Health expectancies from age 50



Source: Our analyses of the Framingham Heart Study

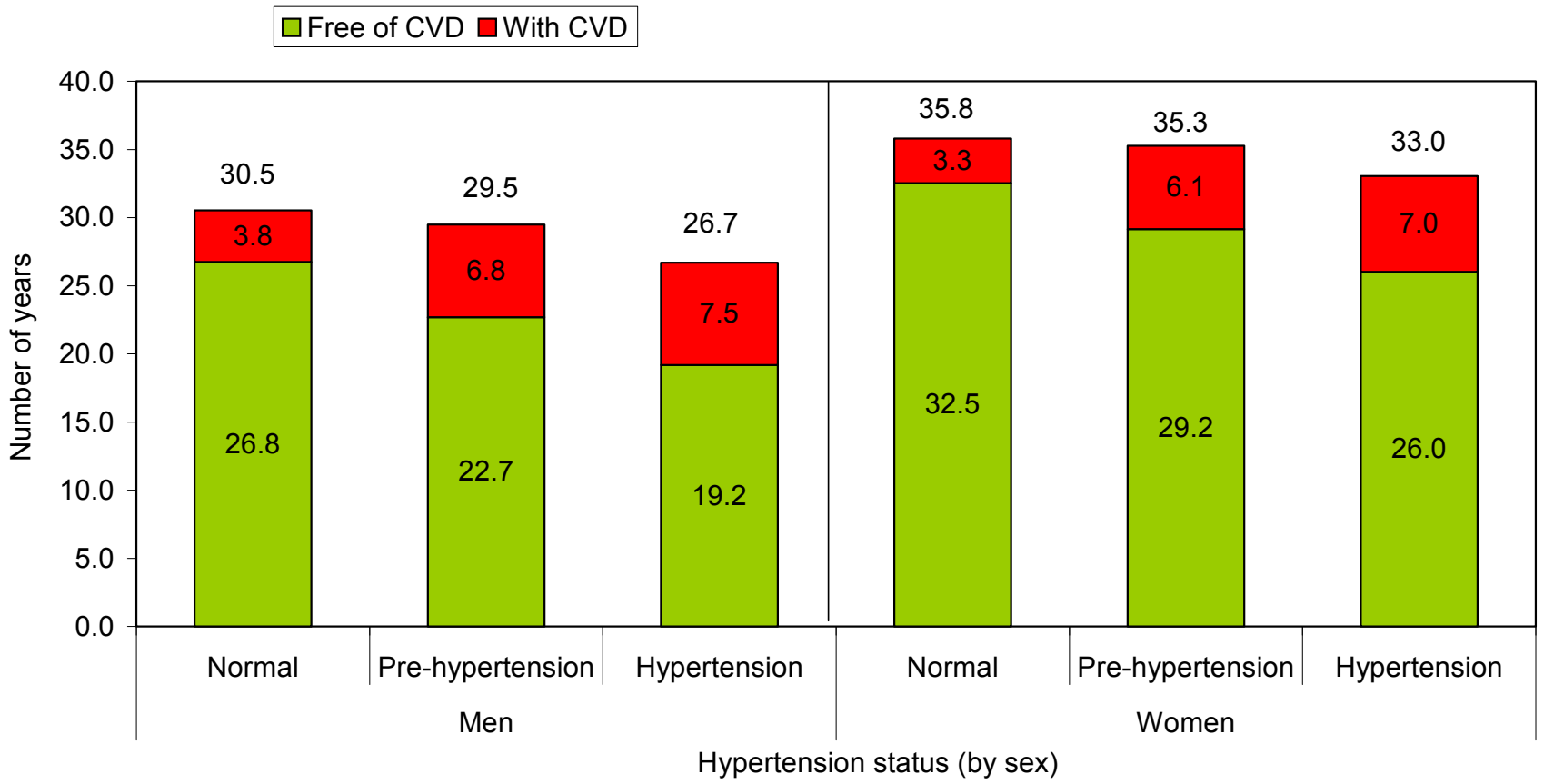
Hypertension
Rate Ratios for 3 transitions



Corrected for age, sex, smoking, BMI, physical activity, co(morbidity), start follow-up . Source: Our analyses of the Framingham Heart Study

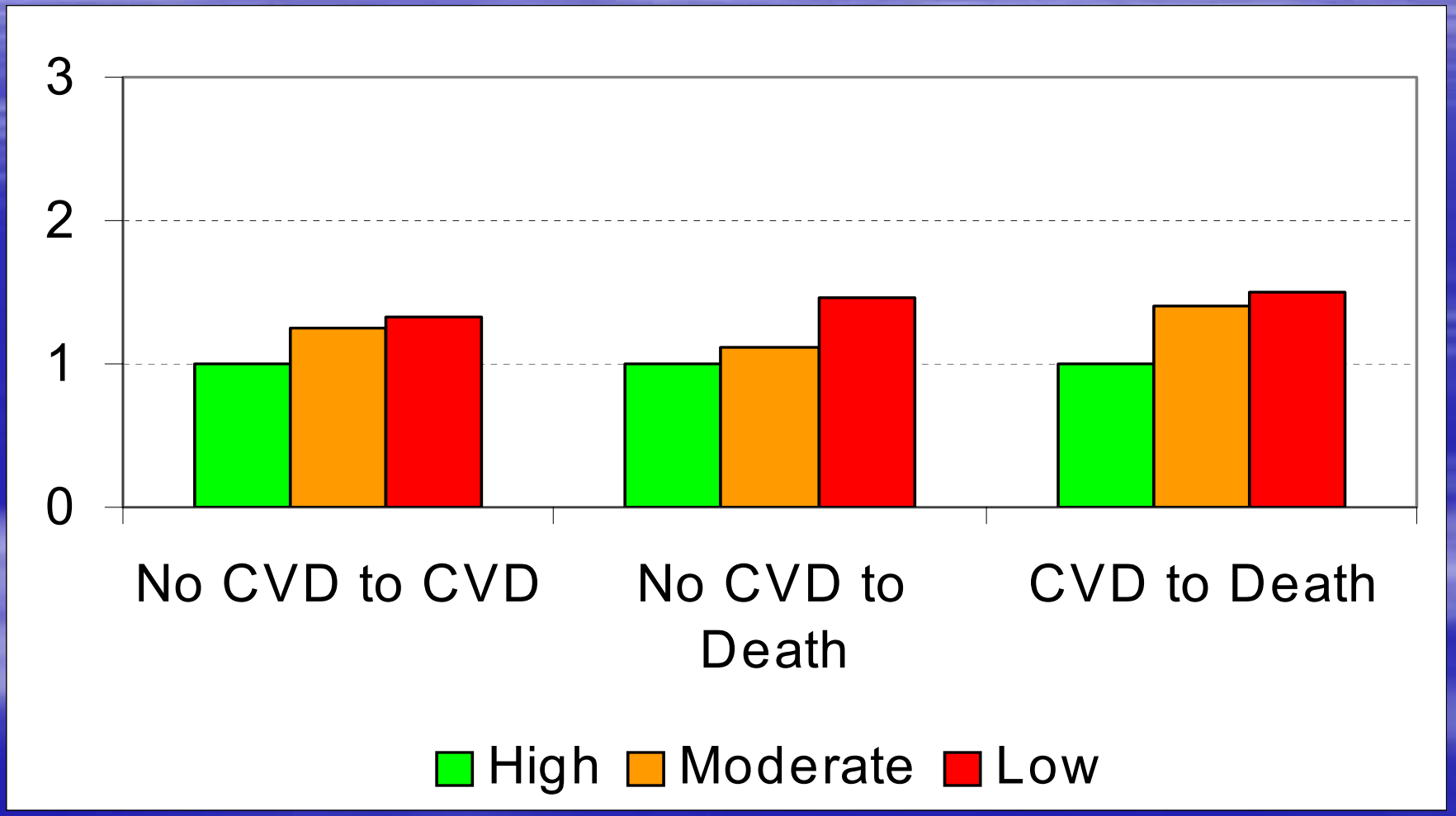
Hypertension
Health expectancies from age 50

Figure 1. Effect of Hypertension at age 50 and over



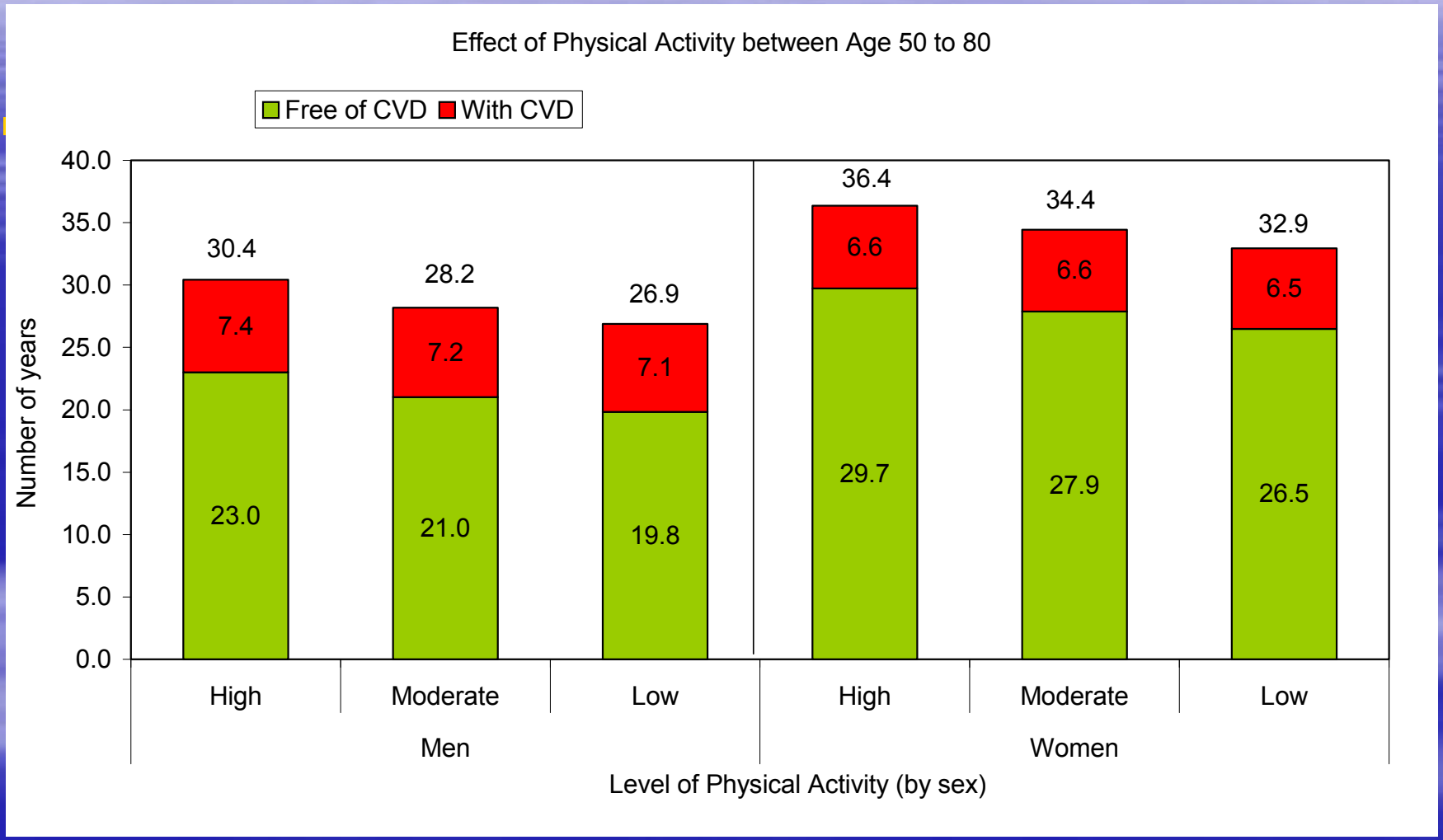
- Source: Our analyses of the Framingham Heart Study

Physical activity
Rate Ratios for 3 transitions



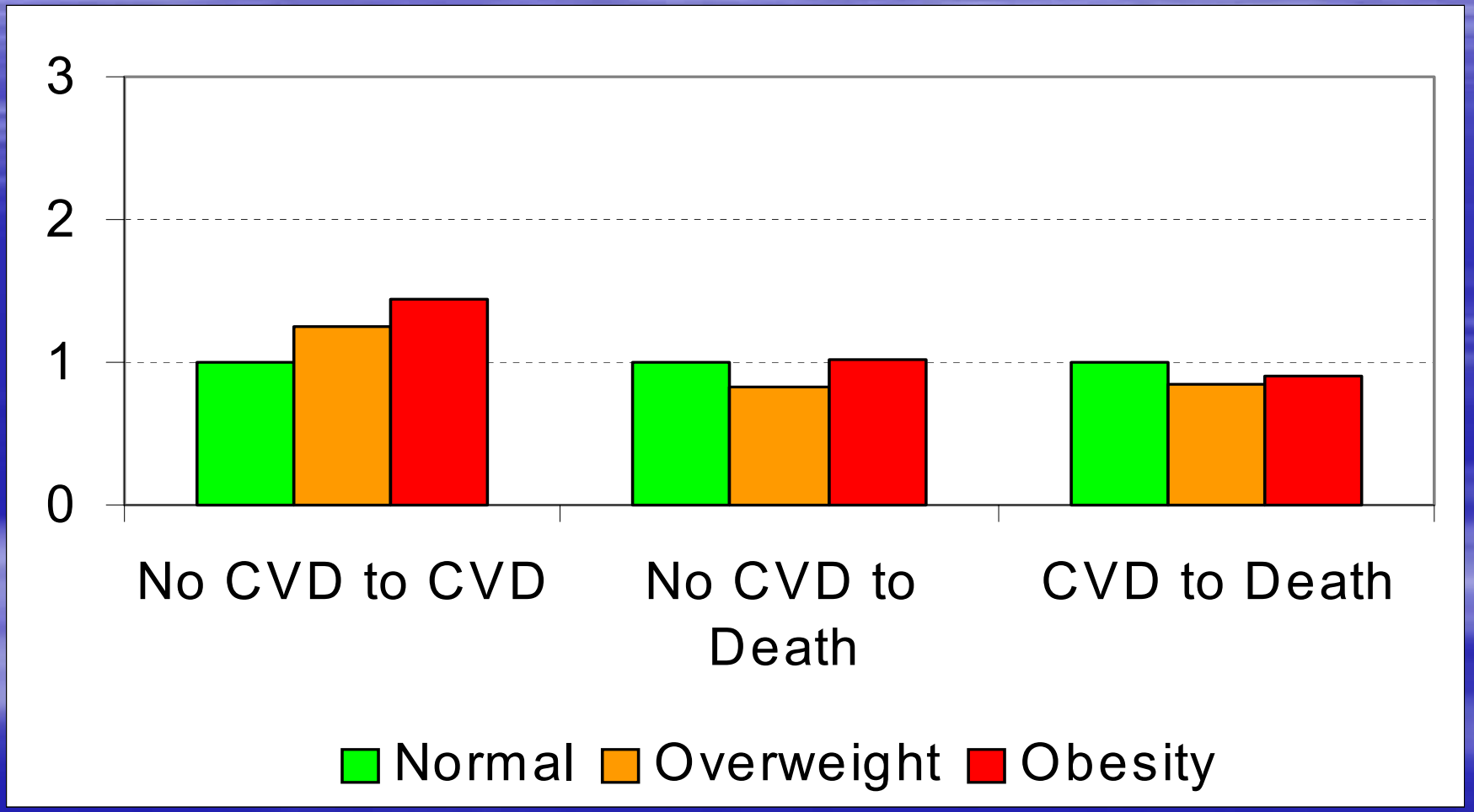
Corrected for age, sex, smoking, co(morbidity), start follow-up. Source:

Physical activity
Health expectancies at age 50



Source: Our analyses of the Framingham Heart Study

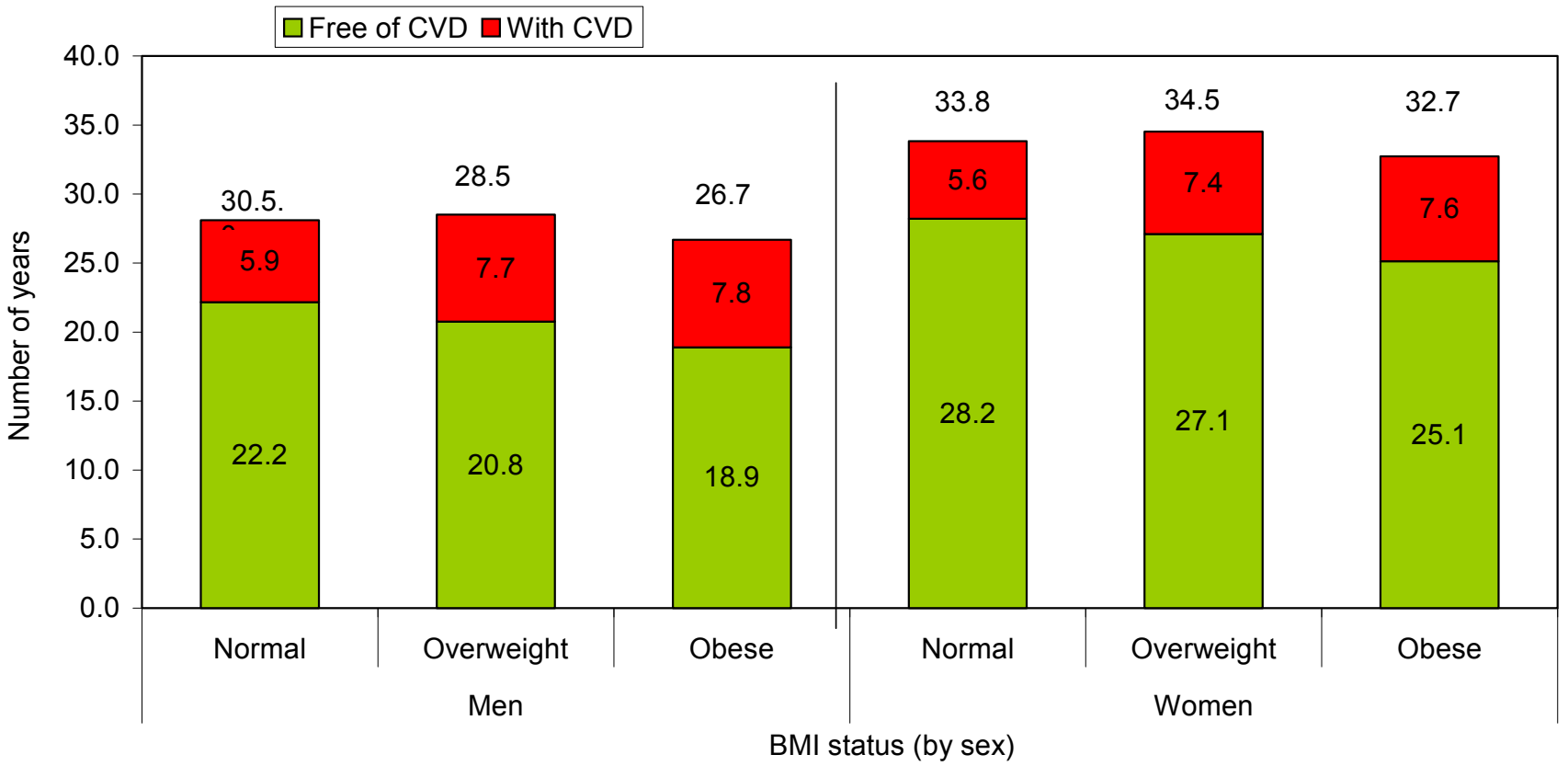
Overweight
Rate Ratios for 3 transitions



Corrected for age, sex, smoking, co(morbidity), start follow-up. Source: Our analyses of the Framingham Heart Study

Overweight
Health expectancies from age 50

Figure 1. Effect of overweight between Age 50 to 80



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COMPREHENSIVE ANALYSIS LIMITATIONS

- Uncertainty about internal validity of empirical relationships, e.g. observational study, sampling error, confounding, …
- Uncertainty about external validity of empirical relationships, e.g. only one data-set, only from age 50, only cardiovascular morbidity, …
- Uncertainty of modelling exercise, e.g. no backflows and memory, not dynamic, …

CONCLUSIONS (1)

- It is theoretically possible, but by no means inevitable, to achieve compression of (cardiovascular) morbidity by lifestyle changes

- It is likely that lifestyle changes have contributed to expansion of (cardiovascular) morbidity during the epidemiologic transition

CONCLUSIONS (2)

- Fries' paper was imprecise in many respects, but probably correct on possibility of compression by lifestyle change
- Firmer conclusions require strengthening of empirical foundations: pooling observational studies, and doing experimental studies

FURTHER READING

- Powerpoint presentation will be posted on my personal webpage, where references to published papers can be found too:

  http://mgzlx4.erasmusmc.nl/pwp?jpmackenbach