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Effects of education and income on cardiovascular disease

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Outline

- Systematic review
- Determination of education and income effects on cardiovascular disease using EGAT data

Background

- Non-communicable diseases (NCD) are responsible for more than two-thirds of global mortality with a total of 52 million deaths projected by 2030[1]
- Cardiovascular diseases (CVDs) are the majority of NCDs, accounting for about 30% of annual global mortality (17.5 million annually) and 10% of the global disease burden.

[1]World Health Organization, 2014, pp.9–22.

- Evidences for the major risk factors of CVDs have been identified by well known studies, e.g., the Framingham Heart Study, WHO-MONICA project, and INTERHEART
- Although interventions that modify these risk factors could reduce cardiovascular morbidity/mortality, CVD remains a major problem in high income countries, and in low- and middle-income developing countries
- Additional risk factors have been therefore tried to identify
- Of those, social determinants of health (SDH) have been increasingly studied

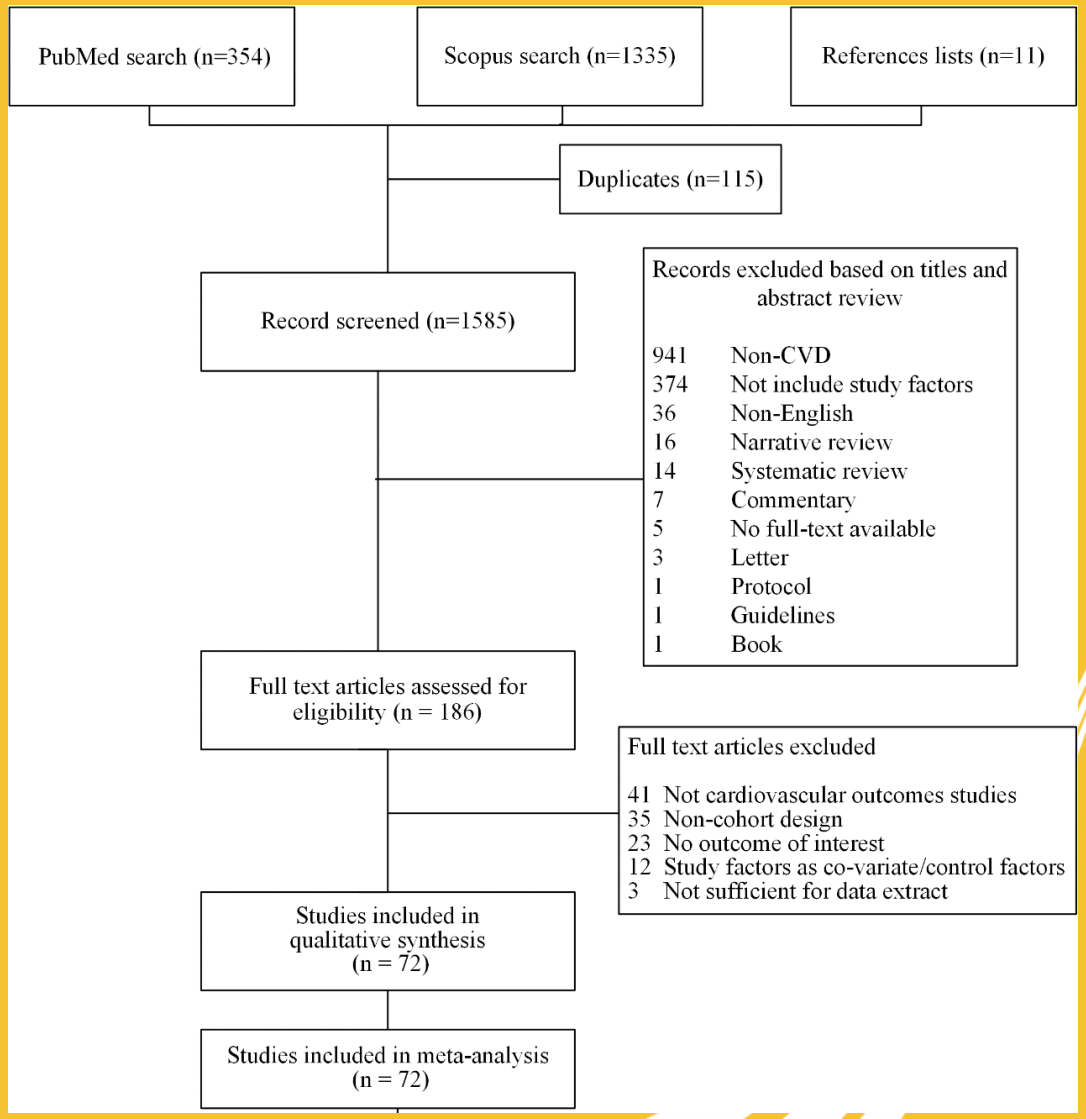
- Some evidences show association between education and CV risk factors (e.g. hypertension, diabetes, dyslipidemias, overweight, etc.) and CVDs/mortality.
- An inverse relationship of income on CVDs
- However, effects of education and income are still inconsistent

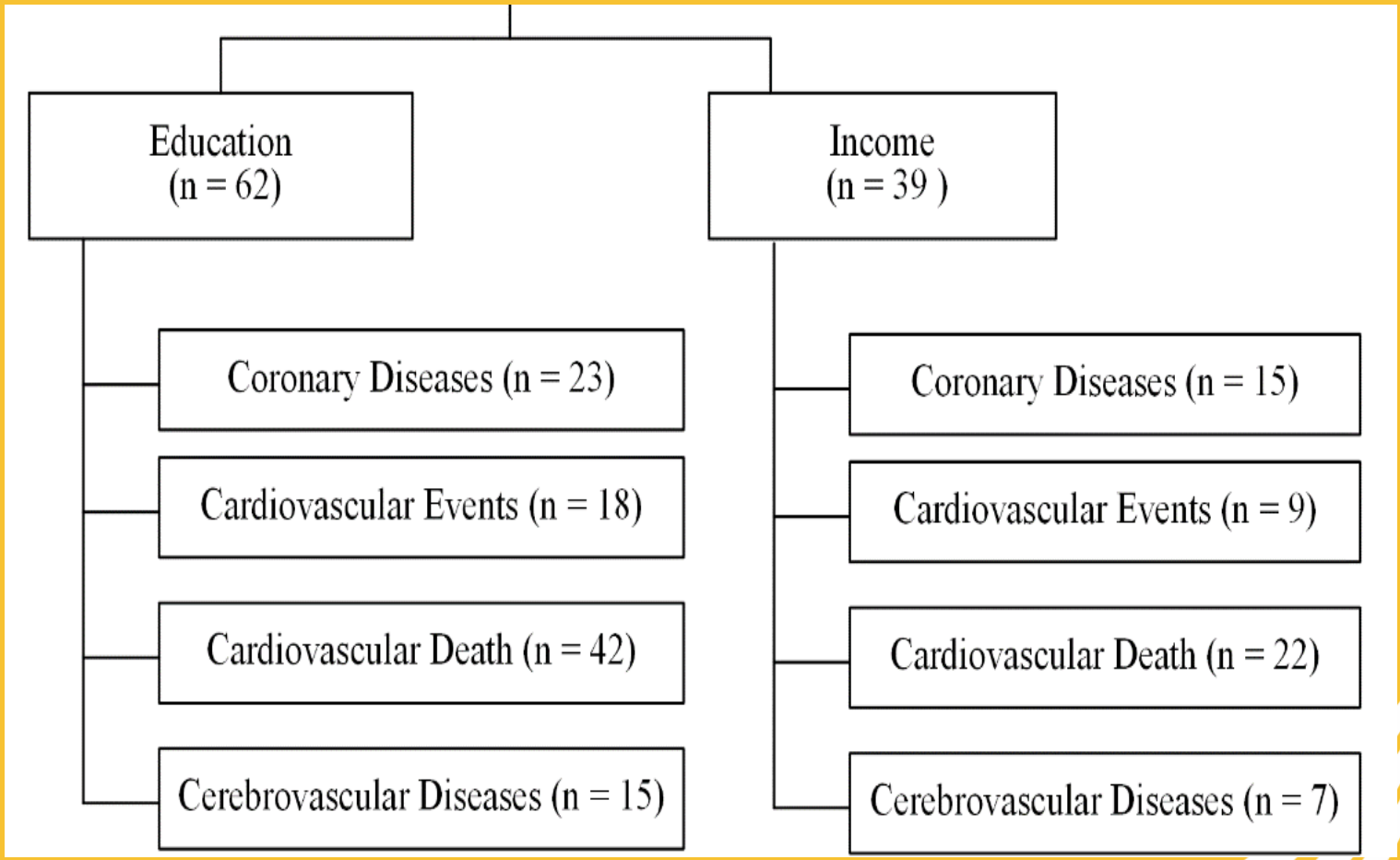
Effects of Education and Income on Cardiovascular Outcomes: A Systematic Review and Meta-Analysis

- To pool effects of education and income on various cardiovascular outcomes

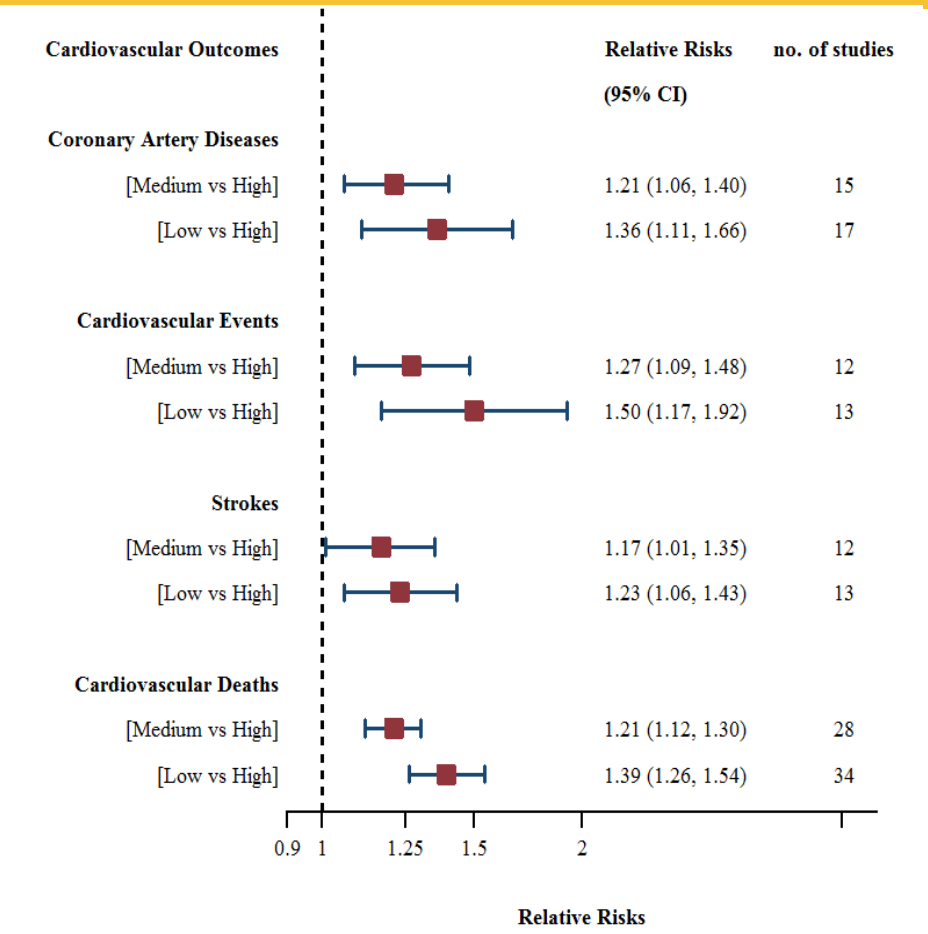
Eur J Prev Cardiol 2017; 24 (10): 1032-1042

Flow of study selections

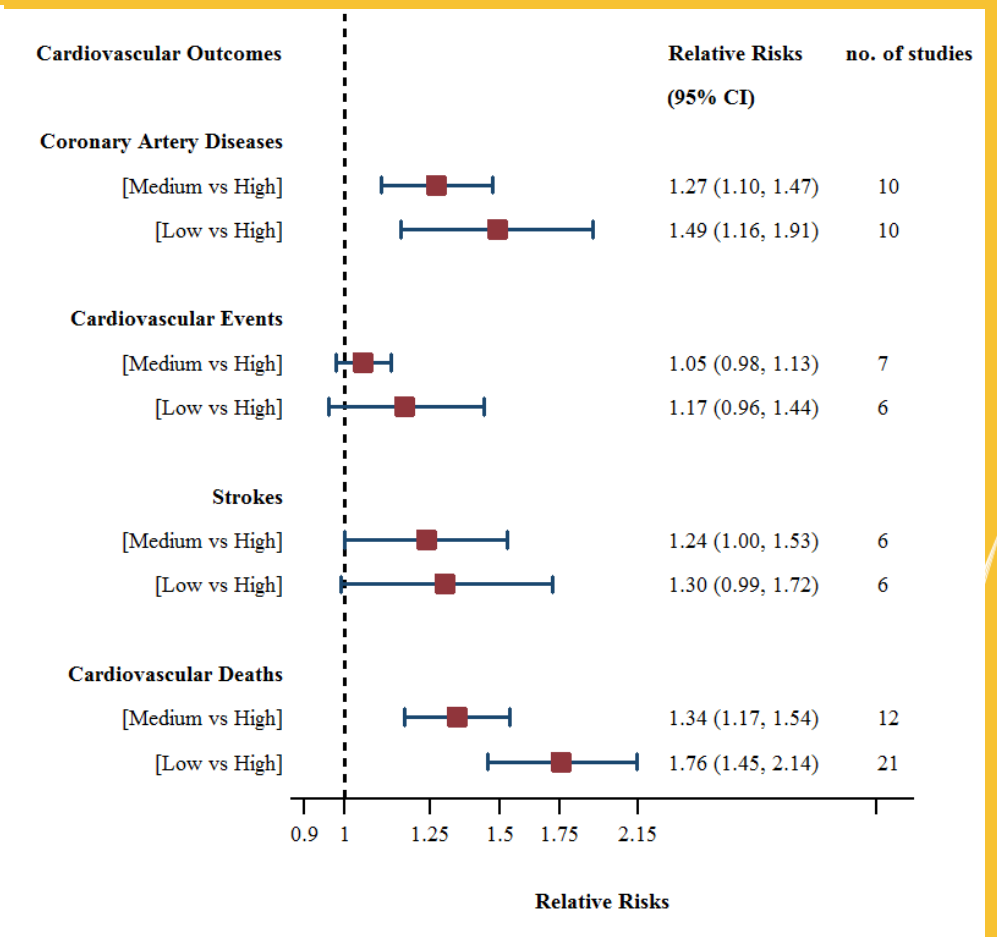



Education
(n = 62)
Income
(n = 39)
Coronary Diseases (n = 23)
Cardiovascular Events (n = 18)
Cardiovascular Death (n = 42)
Cerebrovascular Diseases (n = 15)
Coronary Diseases (n = 15)
Cardiovascular Events (n = 9)
Cardiovascular Death (n = 22)
Cerebrovascular Diseases (n = 7)

Meta-analysis



Pooling effects of education on CVD outcomes

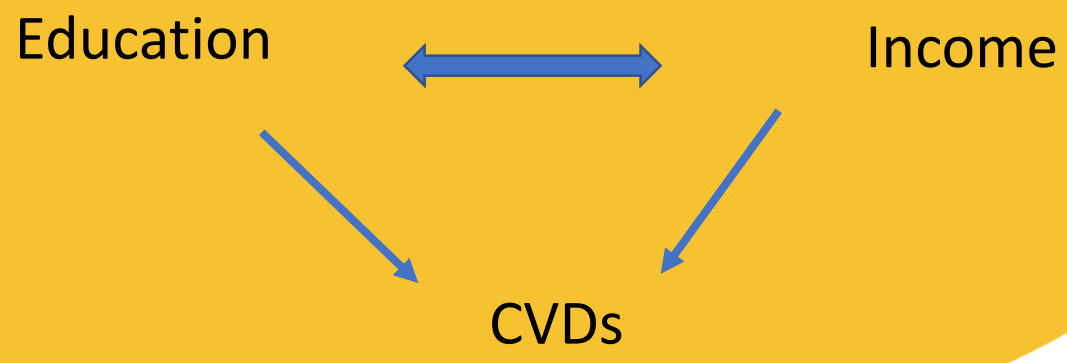


Pooling effects of income on CVD outcomes

Sub-group analysis by countries

		Education				Income			
		n	RR (95% CI)	Q *p*-value	I^2	*n*	RR (95% CI)	Q *p*-value	I^2
Cardiovascular deaths									
Asia	Medium vs high	2	1.12 (0.78–1.60)	0.540	5	0	NA	NA	NA
	Low vs high	8	1.34 (1.04–1.72)	0.024	99	4	1.69 (1.07–2.67)	0.024	96
Europe	Medium vs high	15	1.17 (1.06–1.29)	0.001	99	12	1.40 (1.18–1.67)	<0.001	97
	Low vs high	19	1.32 (1.17–1.49)	<0.001	91	14	1.89 (1.47–2.44)	<0.001	99
USA	Medium vs high	14	1.30 (1.14–1.49)	<0.001	72	1	NA	NA	NA
	Low vs high	8	1.69 (1.28–2.22)	<0.001	95	4	NA	NA	NA

- Our systematic review
  - Provided some evidence of the effects of education and income on CVD outcomes in HICs
  - Education and income are correlated



- Questions
  - Is education or income directly associated with CVDs
  - Is education indirectly associated with CVDs through income
- Therefore, causal association pathways between education and income on CVDs are explored using **Electricity Generating Authority of Thailand (EGAT)** data

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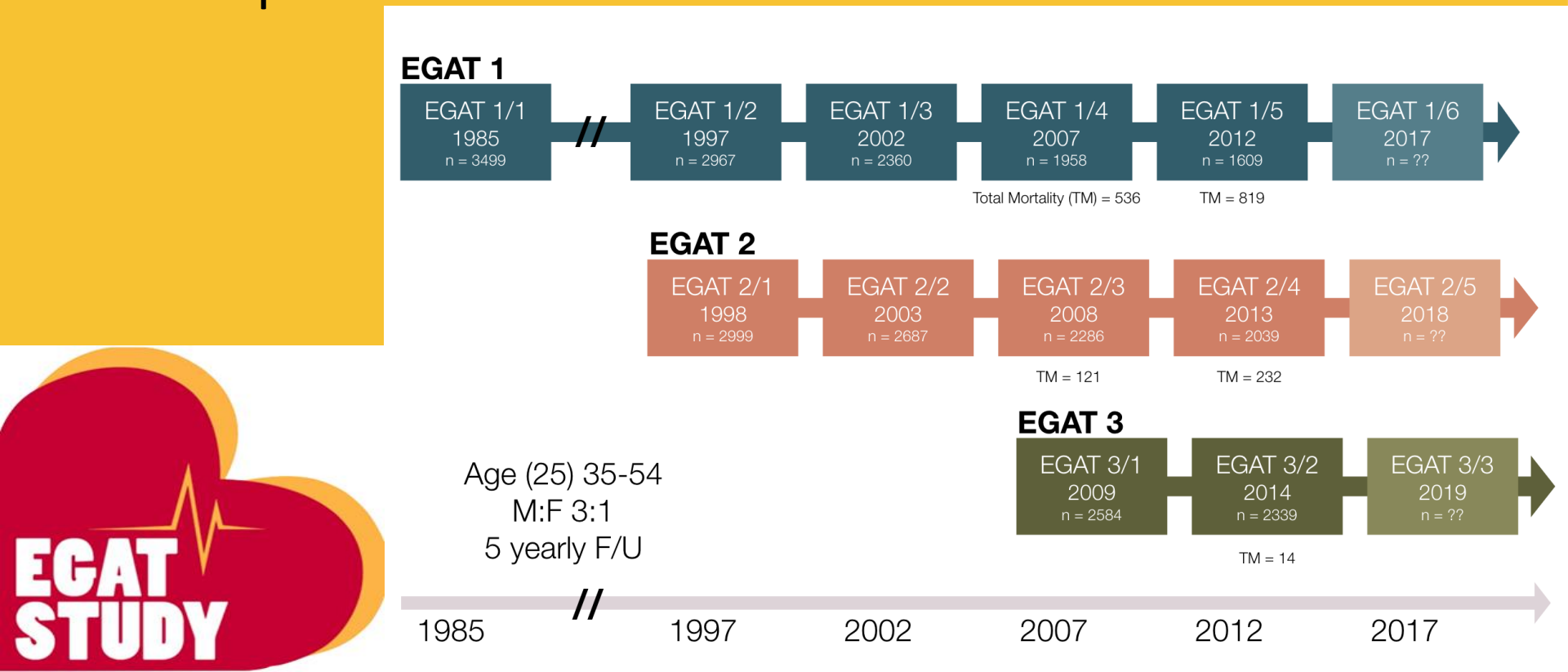
Study design and setting

- Prospective cohort study of EGAT
- Electricity Generating Authority of Thailand (EGAT) cohort - collaborations between Ramathibodi Hospital and EGAT



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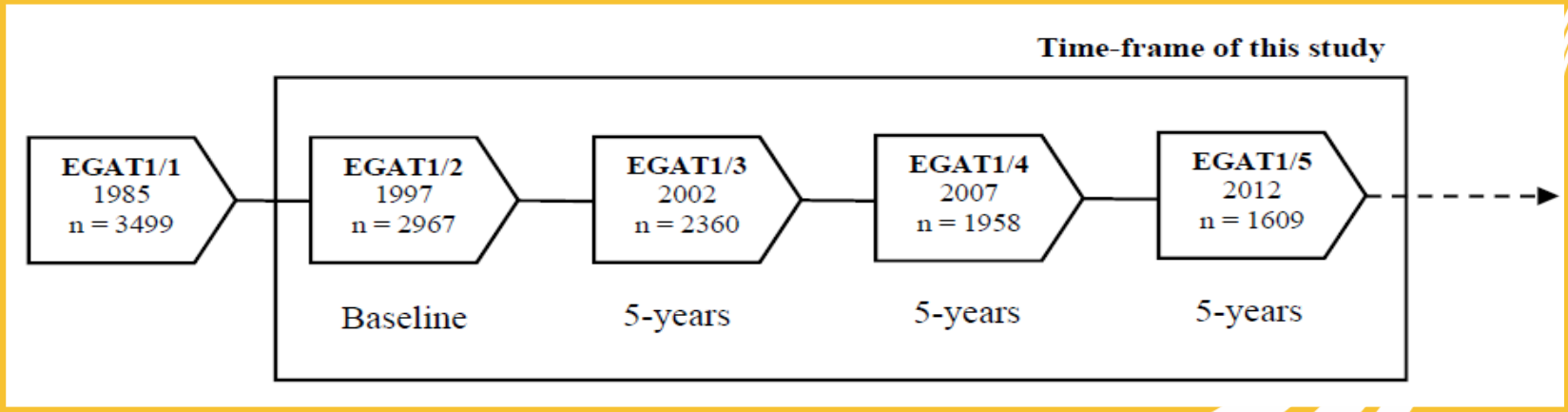
Study subjects

- The EGAT1/2 data was used as baseline data
- Subjects were excluded if they had developed CVDs (i.e., MI, ischemic strokes or TIA and/or CVD death) before/at the second survey in 1997



Study factors

Education

- Education level was extracted from a self-administered questionnaire of EGAT 1/2, 1/3, 1/4
- Education was categorized into 3 groups as
  - Low (≤ high school)
  - Medium (vocational/diploma)
  - High (bachelor/master/PhD)

Study factors

Income

- Categorized into 3 groups
  - Low (<20,000 Baht, ~ <650 $)
  - Medium (20,000 – 50,000 Baht; 650-1628 $)
  - High (>50,000 Baht; > 1628 $)

Interested outcomes

- Incidence of major cardiovascular events (MCVE)
  - CVD death
  - MI
  - Ischemic strokes, and TIA
- All outcomes of interest were verified and validated by a panel of outcome verification team
  - 2 cardiologists
  - 1 neurologist
  - 1 oncologist
  - 1 internist

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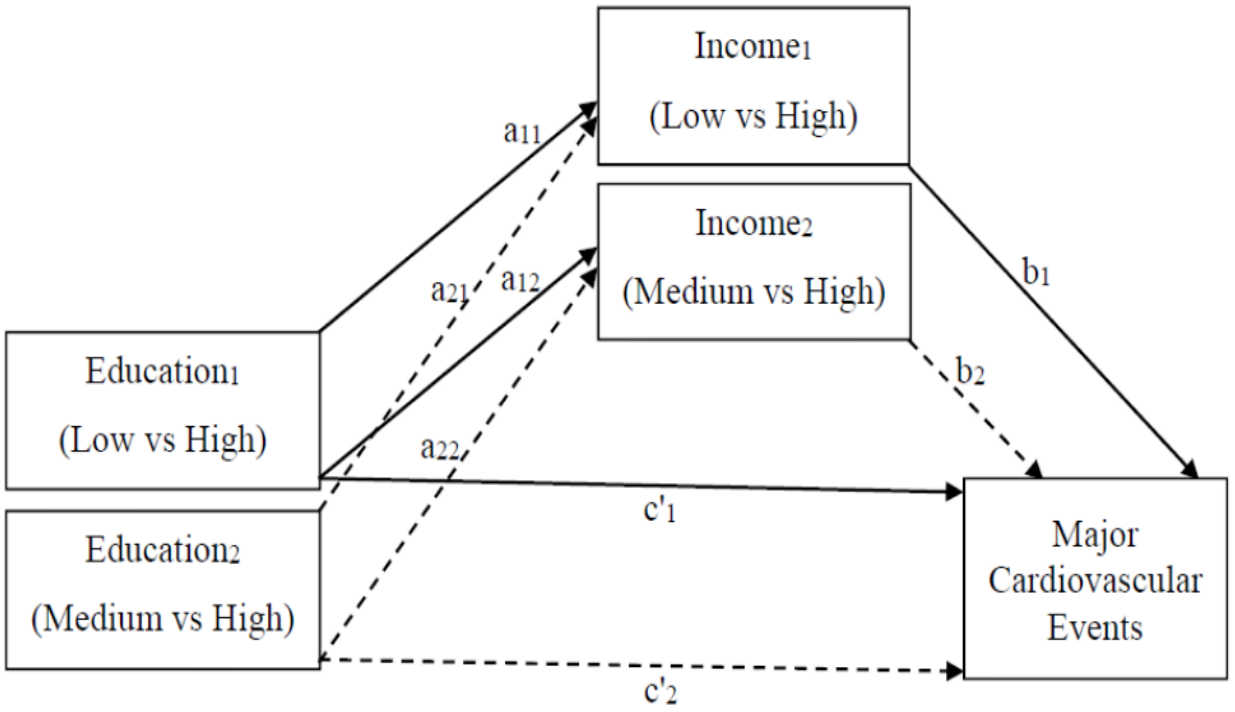
Co-variables

- Age
- Gender
- marital status
- Smoking
- Alcohol consumption
- Exercise/physical activity

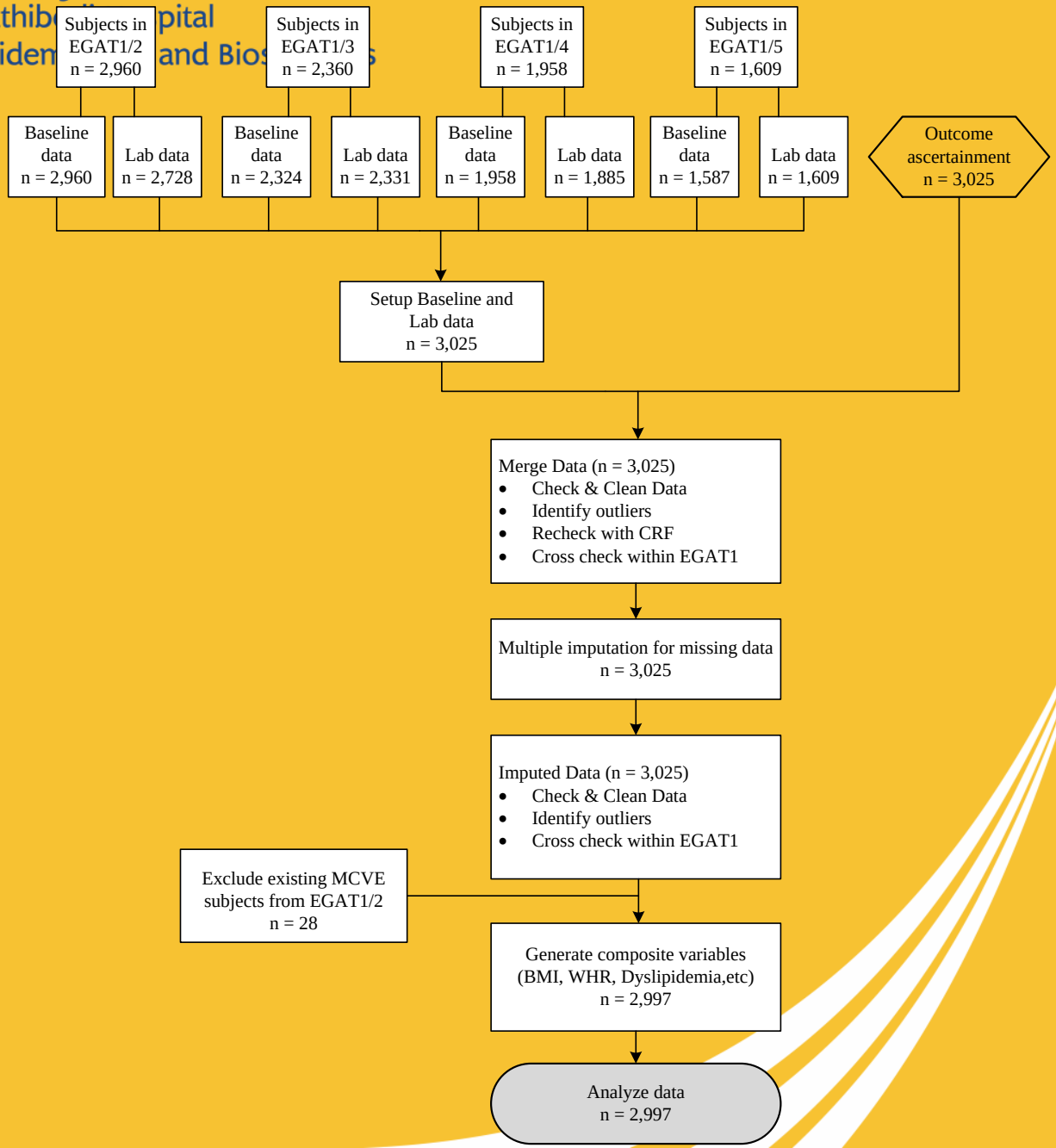
- Body mass index (BMI)
- Waist-hip ratio (WHR)
- Diabetes
- Hypertension
- Dyslipidemia
- Chronic kidney disease

Data analysis



Data analysis

- Mediation analysis by GSEM
  - **Education** was considered as independent variable
  - **Income** was a mediator
  - **MCVE** was the outcome of interest
- Models
  - Mediation model applied multinomial logit link function
  - Outcome model applied logit link function
- A **bootstrap with 1,000 replications** was applied to estimate mediation effects


Subjects in EGAT1/2 n = 2,960
Subjects in EGAT1/3 n = 2,360
Subjects in EGAT1/4 n = 1,958
Subjects in EGAT1/5 n = 1,609
Baseline data n = 2,960
Lab data n = 2,728
Baseline data n = 2,324
Lab data n = 2,331
Baseline data n = 1,958
Lab data n = 1,885
Baseline data n = 1,587
Lab data n = 1,609
Outcome ascertainment n = 3,025
Setup Baseline and Lab data n = 3,025
Merge Data (n = 3,025)
Check & Clean Data
Identify outliers
Recheck with CRF
Cross check within EGAT1
Multiple imputation for missing data n = 3,025
Imputed Data (n = 3,025)
Check & Clean Data
Identify outliers
Cross check within EGAT1
Exclude existing MCVE subjects from EGAT1/2 n = 28
Generate composite variables (BMI, WHR, Dyslipidemia,etc) n = 2,997
Analyze data n = 2,997

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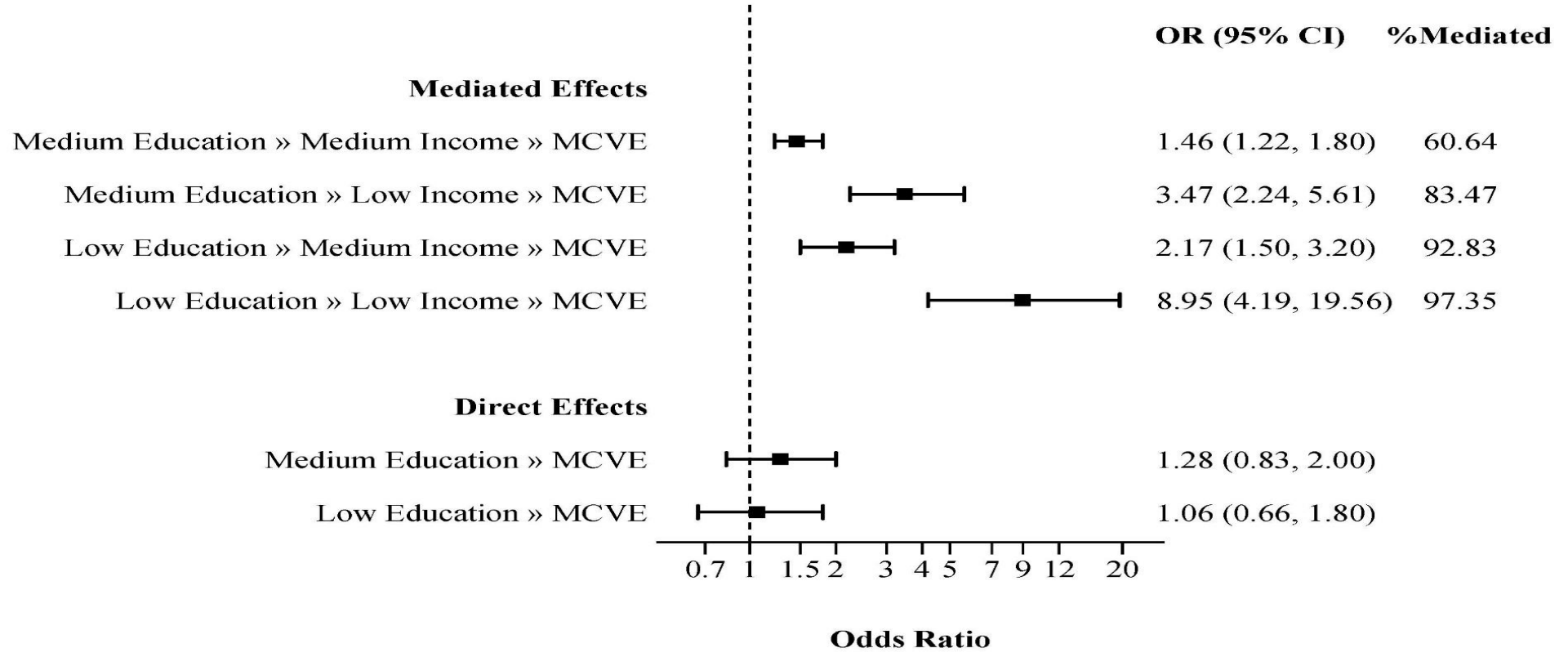
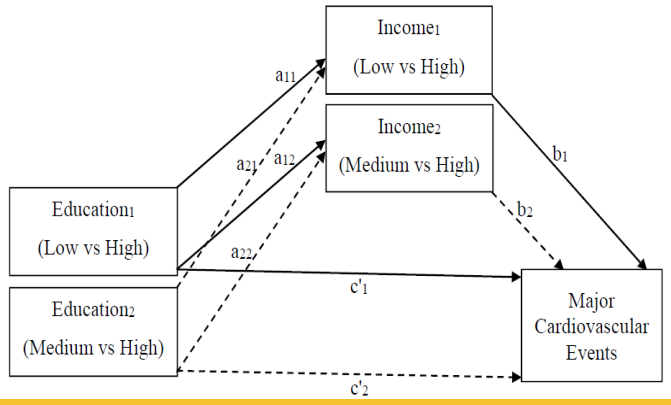
Estimation of MEs





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Summary

- Provided evidence of causal relationship among education and MCVE through income
- Effect of education on MCVE were largely mediated by income
- The gradient effects of education and income on MCVE in the causal pathway were demonstrated.
- The EGAT cohort is more specific group of subjects
- Results would be confirmed using the NHES that are linked with hospital databases

Thank you