

# 연구논문에서 표와 그림의 적절성 평가

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연세의대 예방의학교실  
*EIC, Yonsei Medical Journal*

# IMRaD structure

- Introduction: why ask this research question?
- Methods: what did I do?
- Results: what did I find?
- Discussion: what might it mean?

# Planning a draft paper

<b>Section</b>	<b>Question to be answered</b>	<b>Purpose</b>	<b>Expected length with A4 paper, font size 10–12 and 1.5 line spacing</b>
Introduction	Why did you start?	Summarise the context of your study and state the aims clearly	1 page
Methods	What did you do?	Give enough detail for the study to be repeated	2–3 pages
Results	What did you find?	Describe the study sample and use the data analyses to answer the aims	2–3 pages
Tables and figures	What do the results show?	Clarify the results	3–6 tables or figures
Discussion	What does it mean?	Interpret your findings in context of other literature and describe their potential impact on health care	2–3 pages
References	Who else has done important work in your field?	Cite the most relevant and most recent literature	20–35 references
<b>Total document</b>			<b>12–20 pages</b>

# **IMRaD structure: Introduction**

- Brief background for this audience
- 3-4 paragraphs only
- What's known/not known on research question
- Don't boast about how much you have read

## **The research question**

- State it clearly in last paragraph of introduction
- State why the question matters

# 제 목(Title)

- 논문의 제목만으로도 논문의 내용을 알 수 있어야 한다
- 제목 작성시에는
  - 연구주제를 정확하게,
    - 함축적으로,
      - 구체적으로,
        - 간결하게 표현해야 한다.
- 독립변수, 종속변수, 대상인구의 명시가 있어야 한다.

# Example



American Journal of Epidemiology

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DOI: 10.1093/aje/kwh033

## Hair-coloring Product Use and Risk of Non-Hodgkin's Lymphoma: A Population-based Case-Control Study in Connecticut

Yawei Zhang<sup>1</sup>, Theodore R. Holford<sup>1</sup>, Brian Leaderer<sup>1</sup>, Peter Boyle<sup>2</sup>, Shelia Hoar Zahm<sup>3</sup>, Stuart Flynn<sup>4</sup>, Geovanni Tallini<sup>4</sup>, Patricia H. Owens<sup>1</sup>, and Tongzhang Zheng<sup>1</sup>

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# 서론(IMRAD)

- Brief background for this audience
- 3-4 paragraphs only
- What's known/not known on research question
- Don't boast about how much you have read

## **The research question**

- State it clearly in last paragraph of introduction
- State why the question matters

# 연구방법(IMRAD)

- 재현가능성이 있도록 정확하고 자세하게 기술

## Describe PECO/PICO elements of the study:

- **P** : which patients, which population, what problem(s)?
- **I or E** : which intervention(s) or exposure(s)?
- **C** : which comparison group? Any randomization or stratification?
- **O** : what outcome(s) or endpoint(s)? Define primary and secondary outcome(s)



## Statistical inference

- Report results fully & honestly,  
as pre-specified
- Report primary outcomes first
- Confidence intervals: main results
- Report essential summary statistics
- Leave out non-essential tables  
and figures

- **Text (story)**
- **Tables (evidence)**
- **Figures (highlights)**

## Biological inference: Causality

**Don't simply repeat the introduction.**

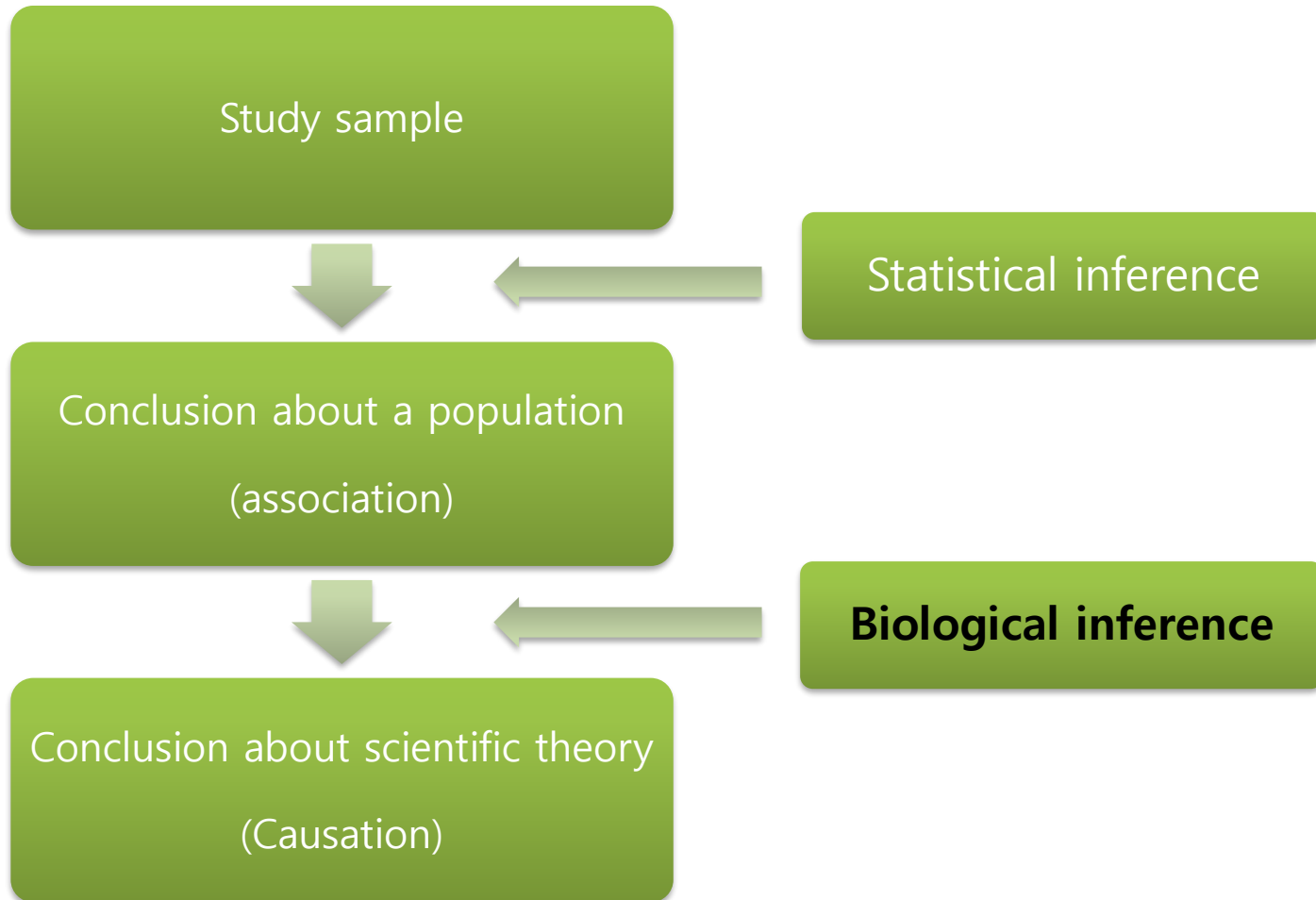
**Include the following : Statement of principal findings**

- Strengths & weaknesses of the study
- Strengths & weaknesses in relation to other studies & key differences
- Possible mechanisms & explanations for findings
- Potential implications for clinicians or policymakers
- Unanswered questions and future research

# Tables and Figures

분석의 일관성  
인과성 추론의 과정

# Overview of the scientific method



# 표의 구성: Statistical inference

**1 : Descriptive statistics**

**- comparison of comparable group**

2 : Confounder identification

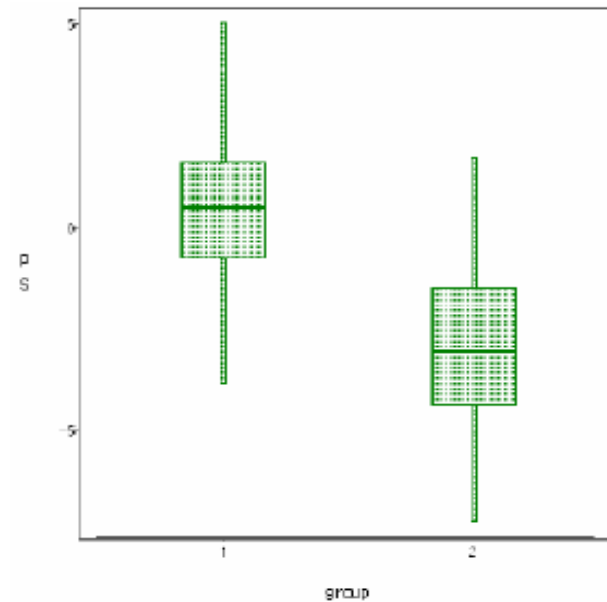
3 : Independent effect or association

4 : Subgroup analysis, etc.,

# Descriptive statistics: Table 1

## - comparison of comparable group-

연도	연도					총합
	1	2	3	4	5	
인원	32	166	317	449	544	1508
표준편차	1.07	5.57	10.63	15.06	18.25	50.59
평균	2.12	11.01	21.02	29.77	36.07	
최대	5.37	27.86	53.19	75.34	91.12	
2	564	430	279	147	53	1473
	18.92	14.42	9.36	4.93	1.78	49.41
	38.29	29.19	18.94	9.98	3.60	
	94.63	72.15	46.81	24.66	8.88	
총합	596	596	596	596	597	2981
	19.99	19.99	19.99	19.99	20.03	100.00



# Summarizing Data: Reporting Data and Descriptive statistics

- **Descriptive statistics: numerical summaries of collections of data**
- **The precision of observations and measurements**
  - 67.837kg → 67.9 kg
- **Percentages**
  - Always give the numerators and denominators  
25% (650/2598), 33% (30 of 90 cases),  
12 of 16 cases (75%)
  - Sample size >100 : one decimal place
  - Sample size <100 : whole numbers
  - Sample size <20 : actual number rather than %  
33% : ?

# Summarizing Data: Categorical Data

- Specify the denominators of rate, ratio, proportions, and percentages

## Example)

Of the 25 tumors, only 5 were malignant.

- **Ratio** of malignant to nonmalignant tumor: 5 : 20
  - **Proportion** of malignant to nonmalignant tumor:  $5/25$ , 0.2
  - **Percentage** of malignant tumor: 20%
  - After 5 years of follow up on each patient, the tumor was malignant in 5 of the 25 patients, giving a 5-year recurrence **rate** of 20% (rate usually is associated with time factor)
- If continuous data have been separated by “cutpoints” into ordinal categories
    - cutpoints and the rationale for choosing them



# Summarizing Data: Continuous Data

- Provide appropriate measures of **central tendency and dispersion** when summarizing data that have a continuous distribution
  - Measure of central tendency: mean, median
  - Measure of dispersion: standard deviation, range, interquartile range
- Do not summarize continuous data with the mean and the standard error of the mean (SEM)
  - SEM : measure of precision for an estimated population mean
  - SD : the variability of the actual data

# Sample presentations (I)

- Use the mean and SD only when describing approximately normally distributed data
- Mean values : one decimal place
- Standard deviations : two decimal place
- Data described with a standard deviation that exceeds one-half the mean are non-normally distributed : median, range or interquartile range

Example)  $45 \pm 25$  mg/dL

95% within about 2SD above and below the mean,

$45 - (25 + 25) = -5$ ,  $45 + (25 + 25) = 95$ : not normally distributed

# Sample presentations (II)

**“Antibody titers ranged from 25 to 347 ng/mL and had a mean (SD) of 110 ng/mL (43 ng/mL)”**

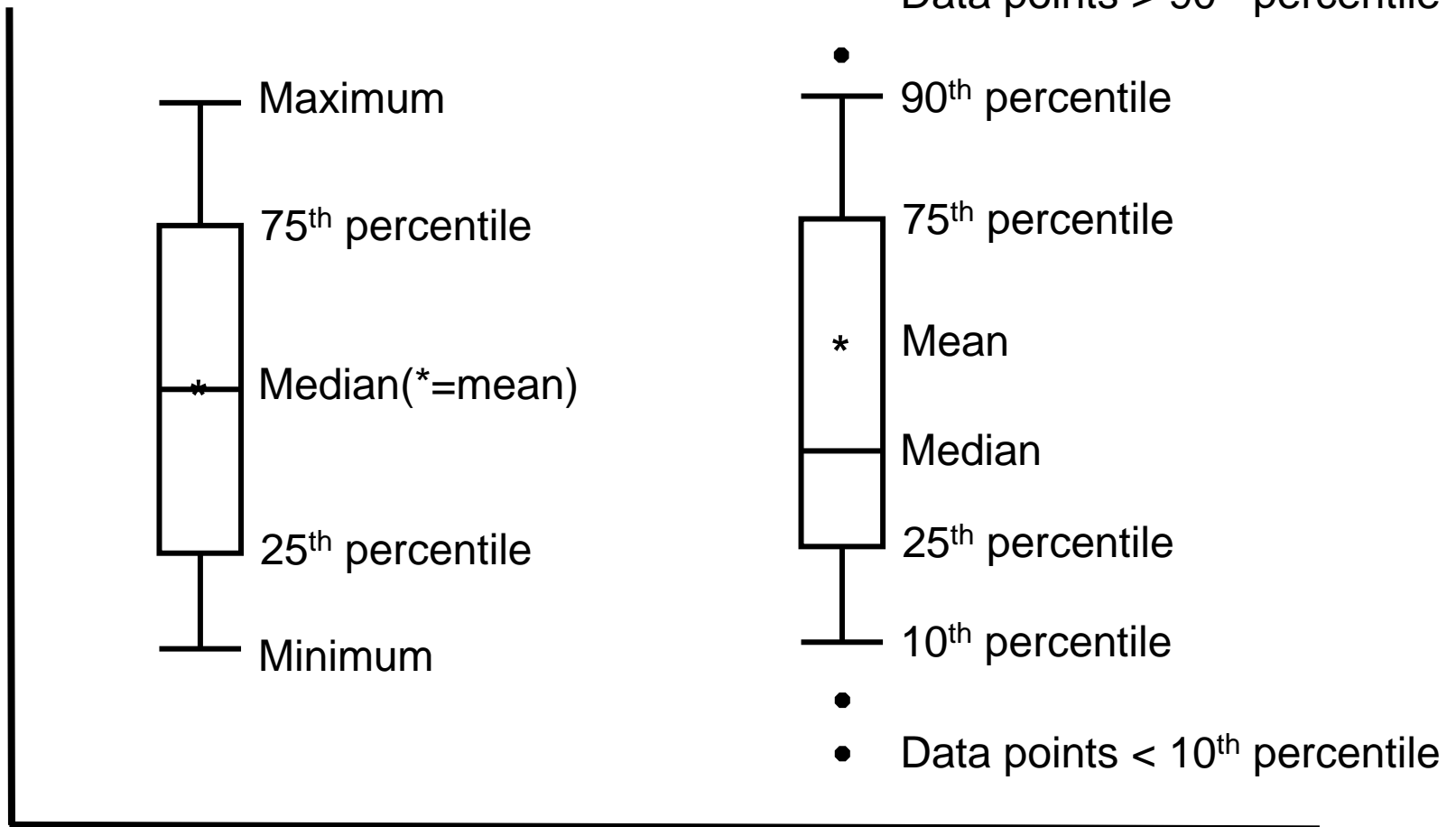
**If the data are approximately normally distributed, they are appropriately described with the mean and standard deviation**

**“Antibody titers ranged from 25 to 347 ng/mL and had a median (interquartile range) of 110 ng/mL (61 to 159 ng/mL)”**

**If the data are markedly normally distributed, they are appropriately described with the median and interquartile range**

**\* Most biological characteristics are not normally distributed**

# Sample presentations (III)



**Normally distributed**

**Non-normally distributed**

# Example

## Postthyroidectomy obesity in a Korean population: does the extent of surgery matter. *Ann Surg Treat Res.* 2019

Variable	Total (n = 227)	Lobectomy (n = 103)	Total thyroidectomy (n = 124)	P-value
Age (yr)	46.0 ± 11.0	43.4 ± 9.7	48.2 ± 11.5	0.001*
Female sex	188 (82.8)	81 (78.6)	107 (86.3)	0.128
Duration (mo)	23.9 ± 16.7	18.4 ± 14.6	28.3 ± 17.0	<0.001*
Menopause (n/female)	63/188	19	44	0.004*
IPAQ	2,566.6 ± 2,734.5	2,562.5 ± 2,780.2	2,570.1 ± 2,707.2	0.983
Inactivity, <600 IPAQ	50 (22.0)	22 (21.4)	28 (22.6)	0.825
Smoking	11 (4.8)	8 (7.8)	3 (2.4)	0.071
Heavy alcohol consumption	19 (8.4)	12 (11.7)	7 (5.6)	0.104
At surgery				
Weight (kg)	62.3 ± 11.9	62.1 ± 12.3	62.4 ± 11.6	0.839
Height (cm)	160.9 ± 7.7	162.4 ± 8.6	159.7 ± 6.8	0.010*
BMI (kg/m <sup>2</sup> )	24.0 ± 3.6	23.5 ± 3.7	24.4 ± 3.5	0.074
Obesity <sup>a)</sup>	88 (38.8)	55 (32.0)	55 (44.4)	0.058
TSH (μU/mL)	1.92 ± 1.20	1.77 ± 0.97	2.04 ± 1.35	0.090
At follow-up				
Weight (kg)	62.6 ± 12.1	62.7 ± 12.7	62.5 ± 11.7	0.908
BMI (kg/m <sup>2</sup> )	24.1 ± 3.6	23.7 ± 3.7	24.4 ± 3.5	0.149
Obesity <sup>a)</sup>	90 (39.6)	34 (33.0)	56 (45.2)	0.062
TSH (μU/mL)	1.02 ± 1.76	1.82 ± 1.86	0.35 ± 1.34	<0.001*
Weight change (kg)	0.36 ± 3.57	0.64 ± 3.56	0.13 ± 3.58	0.284
BMI change (g/m <sup>2</sup> )	0.10 ± 1.42	0.18 ± 1.44	0.03 ± 1.41	0.417

# Example

Variables	Total		Background level		Occupational exposure		Environmental exposure	
	Cases	Controls	Cases	Controls	Cases	Controls	Cases	Controls
	n = 179 (%)	n = 895 (%)	n = 3 (%)	n = 68 (%)	n = 77 (%)	n = 146 (%)	n = 161 (%)	n = 810 (%)
Age (mean ± SD)	78.94 ± 8.43	78.88 ± 8.43	78.00 ± 4.00	75.94 ± 9.66	80.54 ± 7.76	80.89 ± 8.89	79.11 ± 7.75	79.19 ± 8.31
Gender								
Male	151 (20.0)	755 (80.0)	3 (5.0)	57 (95)	73 (34.4)	139 (65.6)	113 (16.3)	681 (83.7)
Female	28 (20.0)	140 (80.0)	0 (0.0)	11 (100)	4 (36.4)	7 (63.6)	28 (17.8)	129 (82.2)
Education level								
< High school	60 (8.6)	635 (91.4)	0 (0.0)	38 (100.0)	31 (21.4)	114 (78.6)	56 (8.8)	582 (91.2)
High school	8 (8.6)	85 (91.4)	0 (0.0)	15 (100.0)	2 (28.6)	5 (71.4)	8 (10.5)	68 (89.5)
> High school	2 (5.6)	34 (94.4)	0 (0.0)	12 (100.0)	0 (0.0)	1 (100.0)	2 (8.3)	22 (91.7)
Unknown	109 (43.6)	141 (56.4)	3 (50.0)	3 (50.0)	44 (62.9)	26 (37.1)	95 (40.8)	138 (59.2)
Smoking status								
Never smoked	44 (11.1)	351 (88.9)	0 (0.0)	26 (100.0)	13 (22.4)	45 (77.6)	43 (11.8)	320 (88.2)
Past smoker	70 (16.7)	350 (83.3)	1 (3.2)	30 (96.8)	36 (39.1)	56 (60.9)	62 (16.5)	314 (83.5)
Current smoker	65 (25.1)	194 (74.9)	2 (14.3)	12 (85.7)	28 (38.4)	45 (61.6)	56 (24.1)	176 (75.9)
Pack-year (mean ± SD)	23.36 ± 22.89	20.88 ± 21.83	24.67 ± 9.50	17.71 ± 18.44	29.68 ± 26.12	24.00 ± 23.05	21.86 ± 22.37	21.11 ± 22.11

# Example

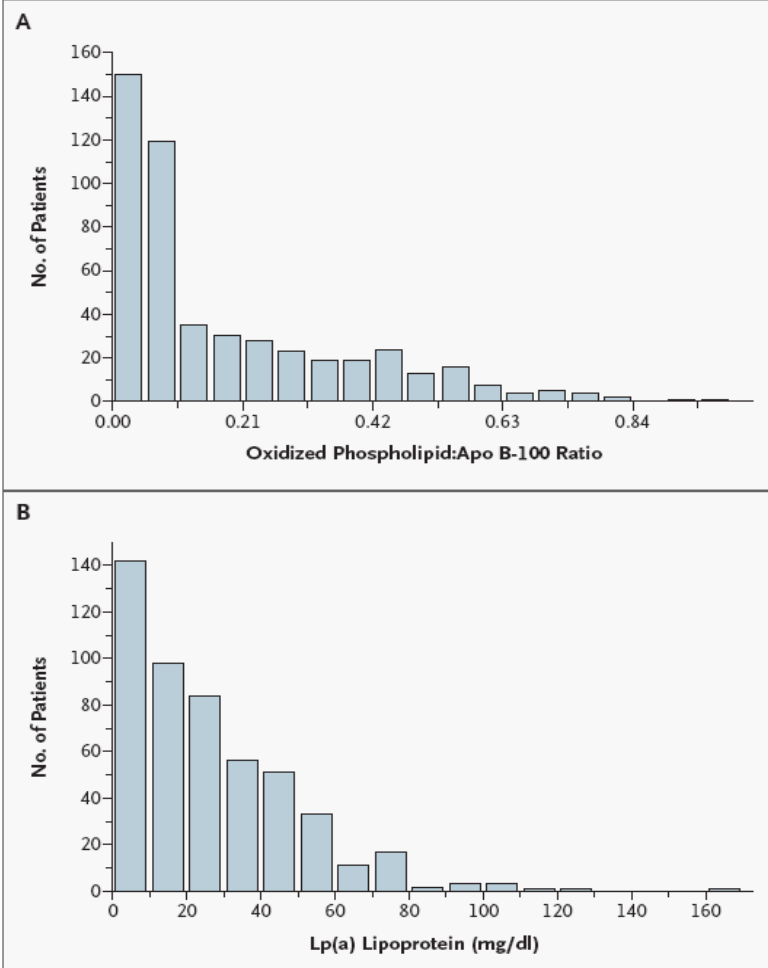
**Table 1. Baseline Characteristics and Lipid Levels in the Study Group.\***

Variable	Value
Age — yr	60.1±10.9
Female sex — no. (%)	193 (38)
White race — no. (%)†	490 (97)
Hypertension — no. (%)	232 (46)
Current smoker — no. (%)	40 (8)
Previous myocardial infarction — no. (%)	77 (15)
Congestive heart failure — no. (%)	59 (12)
Family history of coronary artery disease — no. (%)	128 (25)
Hypercholesterolemia — no. (%)	286 (57)
Statin therapy — no. (%)	142 (28)
Serum creatinine level — mg/dl	
Median	1.1
Interquartile range	1.0–1.3
Indications for angiography — no. (%)‡	
Myocardial infarction within 6 wk before enrollment	41 (8)
Unstable angina	147 (29)
Dyspnea on exertion	137 (27)
Ischemia on nuclear stress test	125 (25)
Other	166 (33)
Lipid levels — mg/dl	
Total cholesterol	207±45
LDL cholesterol	124±37
HDL cholesterol	48±15
Triglycerides	
Median	153
Interquartile range	112–207
Apolipoprotein B-100	98±21
Lp(a) lipoprotein	
Median	21.1
Interquartile range	8.8–39.6
C-reactive protein — mg/liter	
Median	2.9
Interquartile range	1.2–6.7

\* The study group was made up of 504 patients. Plus–minus values are means ±SD. LDL denotes low-density lipoprotein, and HDL high-density lipoprotein.

† Race was self-reported.

‡ Patients could have more than one indication for angiography.



**Figure 1. Frequency Distribution of the Oxidized Phospholipid:Apo B-100 Ratio (Panel A) and Lp(a) Lipoprotein Levels (Panel B).**

Oxidized phospholipid:apo B-100 ratio denotes the oxidized phospholipid content per particle of apolipoprotein B-100.

# 표의 구성: Statistical inference

1 : Descriptive statistics

- comparison of comparable group

**2 : Confounder identification**

**3 : Confounder adjustment**

**- Independent effect or association**

And/or Subgroup analysis, etc.,



# Example

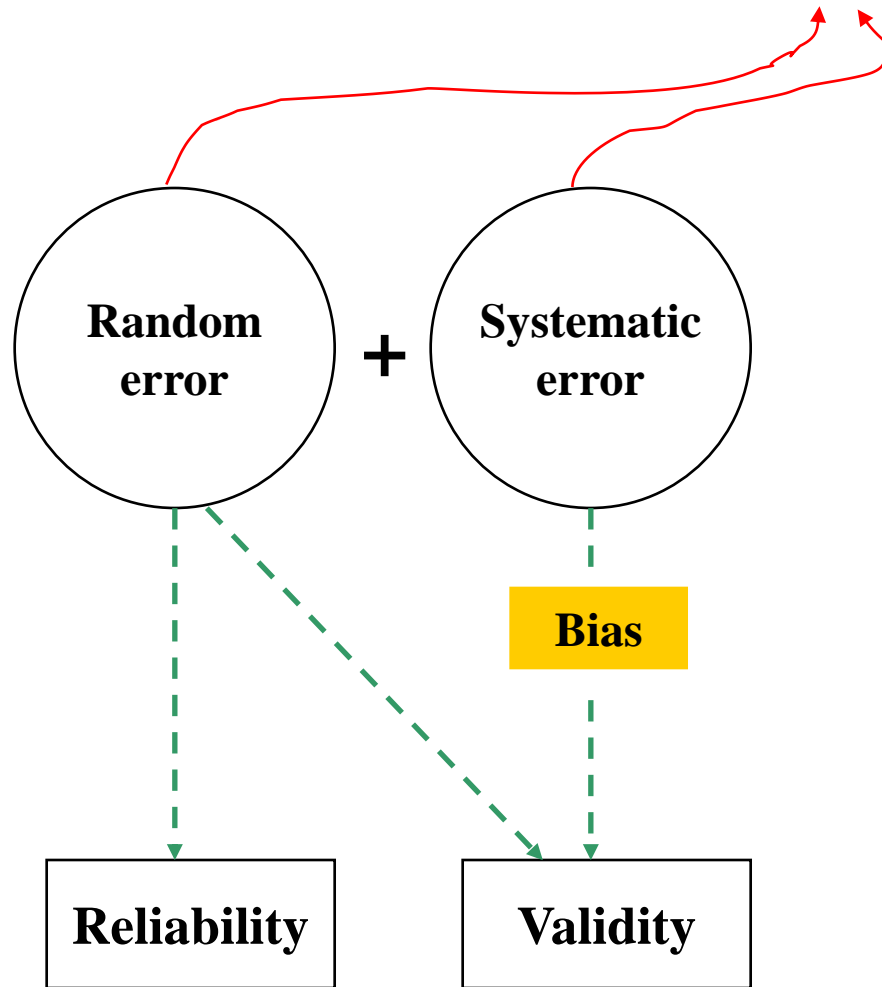
**Table 3.** Univariate and Multivariate Cox Regression Analyses of Histopathological Risk Factors Based on Tumor Specimens from Radical Prostatectomy.

End Point and Risk Factor	No. of Men	No. of Events	Relative Risk with Adjustment for Age Group (95% CI)**	Relative Risk with Adjustment for Age Group and Additional Factors (95% CI)†
<b>Distant metastasis</b>				
Margins				
Negative	184	29	Reference	Reference
Positive	99	32	2.73 (1.63–4.57)	1.26 (0.73–2.20)
Extracapsular extension				
Absent	151	13	Reference	Reference
Present	132	47	6.59 (3.54–12.27)	4.50 (2.34–8.64)
Gleason score of prostatectomy specimen				
3–6	88	4	Reference	Reference
7	157	37	6.27 (2.23–17.59)	3.10 (1.05–9.11)
8 or 9	38	20	17.82 (6.08–52.28)	9.44 (3.09–28.84)
<b>Death from prostate cancer</b>				
Margins				
Negative	184	24	Reference	Reference
Positive	99	24	2.55 (1.42–4.56)	1.16 (0.62–2.15)
Extracapsular extension				
Absent	151	9	Reference	Reference
Present	132	38	7.61 (3.66–15.84)	5.21 (2.42–11.22)
Gleason score of prostatectomy specimen				
3–6	88	3	Reference	Reference
3+4	87	5	1.91 (0.46–7.99)	0.99 (0.23–4.33)
4+3	70	21	11.78 (3.51–39.55)	5.73 (1.59–20.67)
8 or 9	38	19	20.06 (5.93–67.91)	10.63 (3.03–37.30)

\* The model was adjusted for age group (<65 vs. ≥65 years).

† The model was adjusted for age group (<65 vs. ≥65 years), PSA level, margins, capsular extension, and Gleason score.

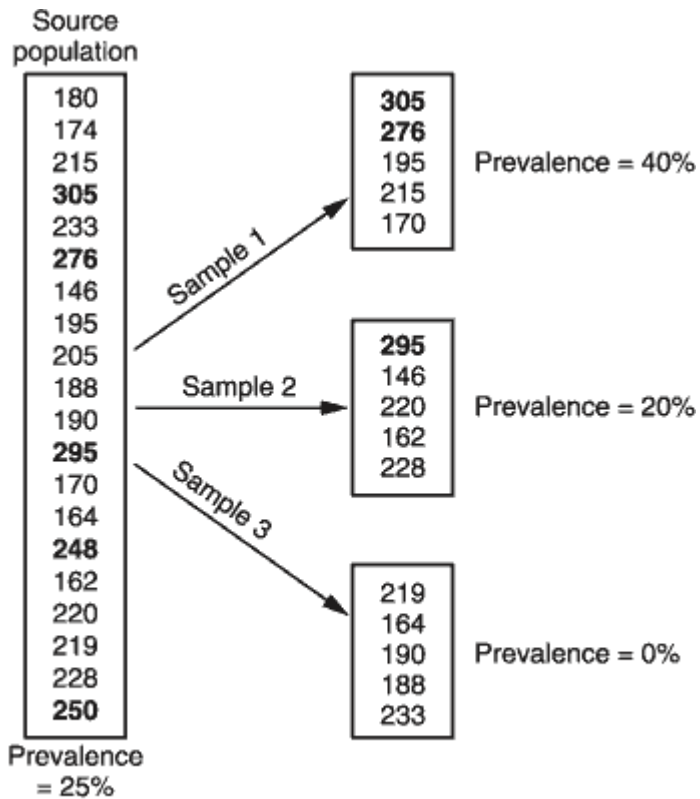
참 값 = 관 측 값 + “오 차”



# Random Error

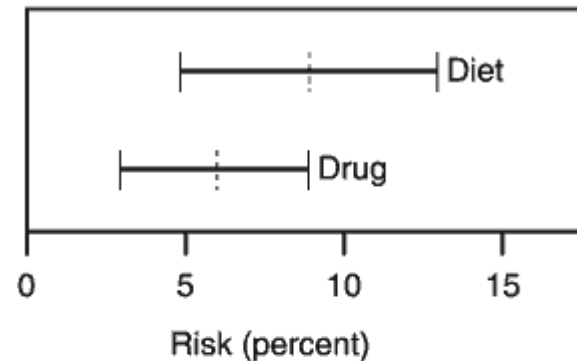
- The defining characteristic of random error is that it is due to “chance” and, as such, is unpredictable
  - Ex) tossing a coin 100 times where the aim is to test the hypothesis that the coin is “fair”
    - to completely eliminate random error → toss the coin an “infinite” number of times
- Clinical or Epidemiologic studies: randomly sampled from a “population.”
  - the null hypothesis is rejected when it is true: type I error ( $\alpha$ )
  - the null hypothesis is not rejected when it is false: type II error ( $\beta$ )
  - $\alpha$  and  $\beta = 0$  ?
    - For a given sample size there is a tradeoff between type I error and type II error

# Random Error: 표본 크기, 95% CI

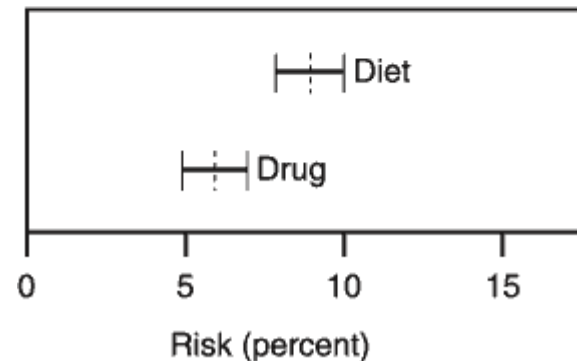


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Study A (200 subjects)



Study B (2000 subjects)



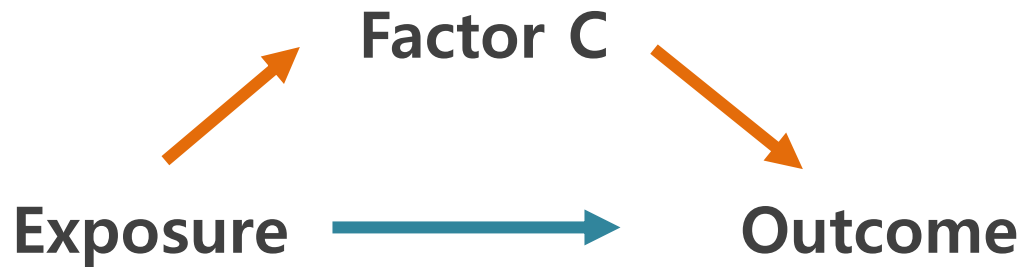
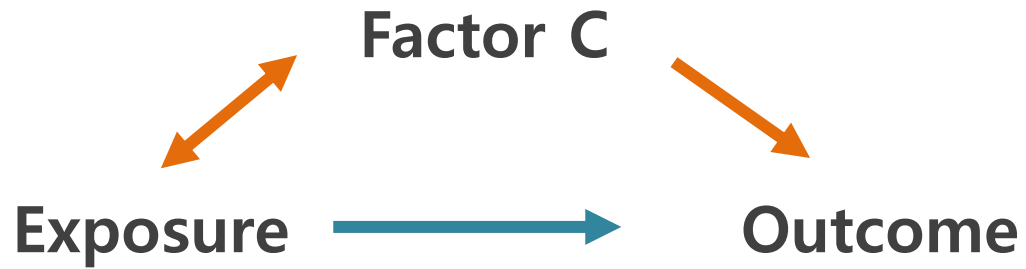
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$$95\% \text{ CI} = X \pm 1.96 \times SE$$

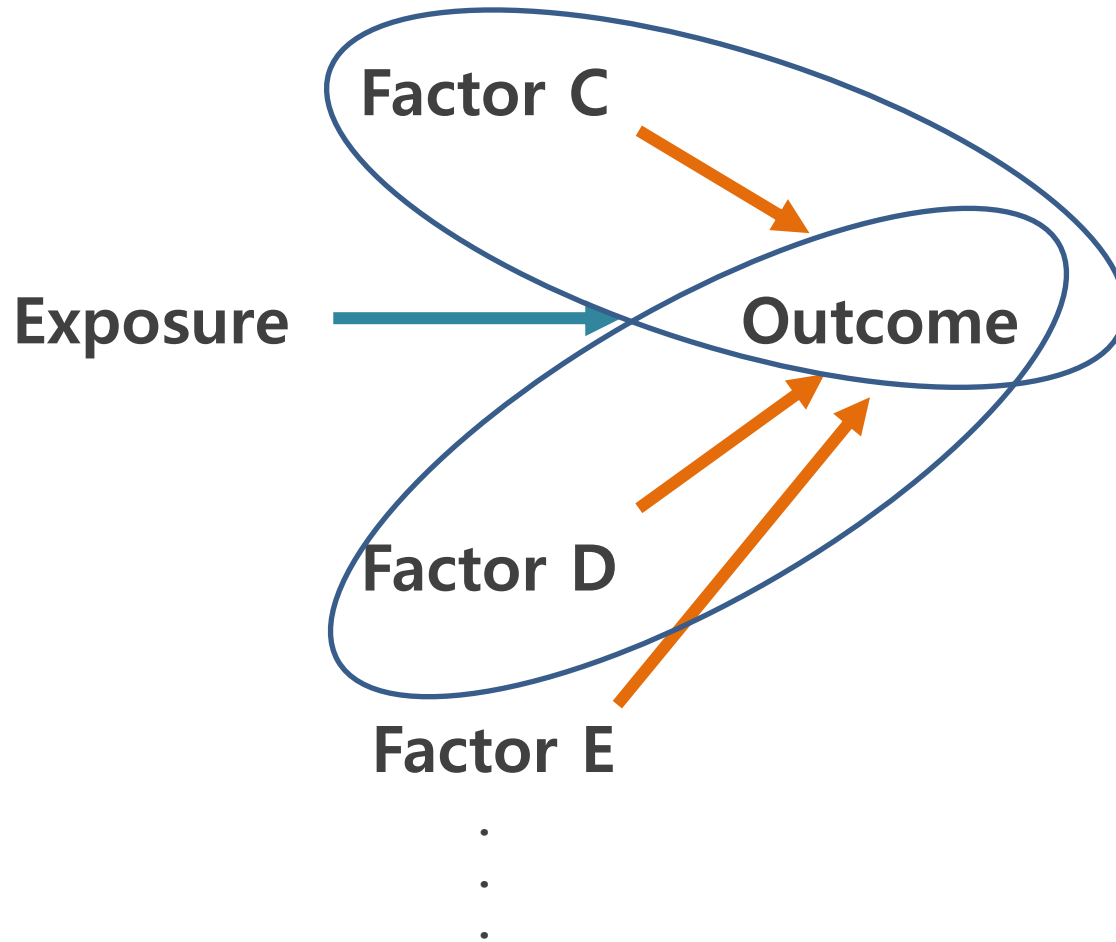
# Systematic error

- **Systematic error: reproducible**
- **Result of problems having to do with study methodology**
  - the study sample could be chosen improperly
  - the questionnaire could be invalid
  - the statistical analysis could be faulty
- **Bias, Confounding**

# 혼란변수



# 혼란변수



# Example

**Table 2.** Univariate and multivariate analysis of predictors associated with postthyroidectomy obesity (BMI  $\geq$  25 kg/m<sup>2</sup>)

Variable	Univariate analysis P-value	Multivariate analysis	
		OR (95% CI)	P-value
Age (yr)	0.626		
Female sex	0.658		
Duration (mo)	0.039	1.032 (1.002–1.063)	0.035
Menopause state	0.615		
IPAQ	0.782		
Smoking	0.369		
Alcohol consumption	0.059	6.492 (1.250–33.712)	0.026
Preoperative BMI (kg/m <sup>2</sup> )	<0.001	3.945 (2.646–5.883)	<0.001
Total thyroidectomy	0.920		
Preoperative TSH ( $\mu$ U/mL)	0.697		
Postoperative TSH ( $\mu$ U/mL)	0.346		

Variables with P < 0.10 in the univariate analysis were included in the multivariate analysis.

BMI, body mass index; OR, odds ratio; CI, confidence interval; IPAQ, International Physical Activity Questionnaire.



# 표와 그림의 적절성

- **Text : story**
- **Tables or Figures**
  - ✓ **Evidence: causality, association ....**
  - ✓ **Figure: Highlights**

**감사합니다.**