肥胖與慢性腎臟病風險之相關性：以國家代表性橫斷面研究探討

Association between obesity and the risk of chronic kidney disease from the national representative cross-sectional study

實習單位：衛生福利部國民健康署 慢性疾病防治組

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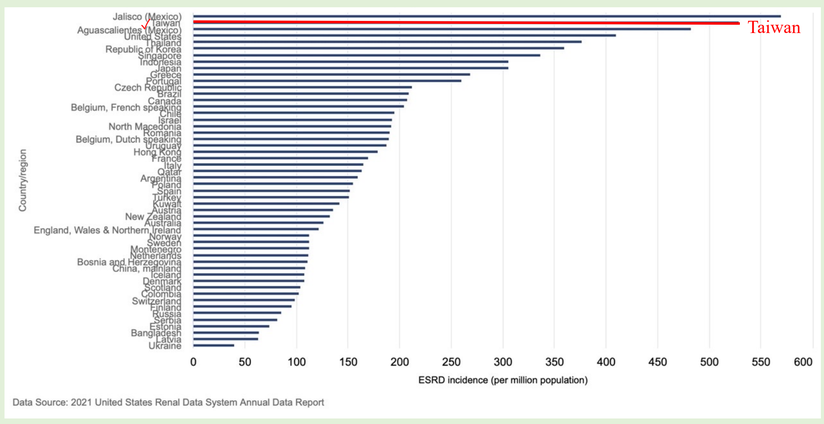
Introduction

Chronic kidney disease (CKD):

- According to the Kidney Disease: Improving Global Outcomes (KDIGO) 2012 Clinical Practice Guideline, CKD is defined as abnormalities of kidney structure or function, present for ＞3 months (＞90 days), with implications for health.
- Criteria for CKD
  - ■Glomerular filtration rate (GFR) ＜60 ml/min/1.73 m^2 (GFR categories G3a-G5)
  - ■Albuminuria (Albumin-to-creatinine ratio, ACR≧30 mg/g [≧3 mg/mmol])
  - ■Urine sediment abnormalities
  - ■Electrolyte and other abnormalities due to tubular disorders
  - ■Abnormalities detected by histology
  - ■Structural abnormalities detected by imaging
  - ■History of kidney transplantation
- 14.4% of the U.S. adult population surveyed in 2015-2018 in the National Health and Nutrition Examination Survey (NHANES) had CKD based on a low estimated glomerular filtration rate (eGFR) or albuminuria.
- Diabetes and hypertension were strong predictors for the development and progression of CKD.



- According to the United States Renal Data System (USRDS) 2021 Annual Data Report, in 2019, the incidence rate of ESRD in Taiwan was 529 per million population.
- There were many risk factors of CKD, among which obesity was one of the most important factors.

Obesity:

- Obesity has become a pandemic, one of the most serious global health issues. The prevalence of obesity has been significantly increasing worldwide.
- Body mass index (BMI) is a standard measurement to be used to define obesity.
- The BMI was calculated as the weight in kilograms divided by the square of height in meters.
  - ■**Underweight** (BMI<18.5), **normal** (18.5≤BMI<24), **overweight** (24≤BMI<27), and **obese** (BMI≥27) according to the recommendations of the Health Promotion Administration (HPA).
- According to the 2013-2016 Nutrition and Health Survey in Taiwan (NAHSIT), the prevalence of overweight and obesity among adults in Taiwan was 45.4%. (53.4% for men and 38.3% for women)

Central obesity: (or abdominal obesity)

- waist circumference **≧90 cm in males** and **≧80 cm in females** according to the recommendations of the HPA.
- Central obesity produced excessive pro-inflammatory adipokines, reduced anti-inflammatory adipokines and enhanced macrophage infiltration in adipose tissues.
- Renal vascular resistance would increase, renal blood flow and glomerular filtration rate would reduce.

Study aim:

Many studies indicated that hypertension, diabetes, and high blood lipids could cause chronic kidney disease. However, obesity is a factor that causes hypertension, diabetes, and high blood lipids. Therefore, I would like to get the following aim:

- To research the association between obesity and chronic kidney disease.
- To research the confounding factors of chronic kidney disease.
- give some suggestions of health policy to promote health literacy.

Materials & Methods

- Searching in electronic databases “PubMed”, and used Boolean logic to search for experimental studies by keywords.

1. Articles were screened from titles and abstracts
2. Read full text
3. Selected appropriate literatures for the results and discussion

(Keywords: obesity, abdominal obesity, chronic kidney disease, body mass index, waist, hip and diabetes mellitus.)

Results

Author/ Year	Study design	Region /study	N/ range of age/ Women %	Obesity criteria	CKD criteria	Confounding factors	Statistical analyses	Results
Stengel/ 2003	Cohort	U.S./ NHANES 1976-1980	9082/ 30-74/ 53	World Health Organization, 1997: thin (BMI<18.5 kg/m^2), normal weight (18.5≦BMI<25), overweight (25≦BMI<30), obese (30≦BMI<35) and morbidly obese (BMI≧35)	treatment of end-stage kidney disease due to any cause; or death related to chronic kidney disease	age, gender, race, physical activity, smoking, alcohol, BMI, diabetes, cardiovascular disease, hypertension, systolic blood pressure, serum cholesterol and estimated glomerular filtration rate	Poisson models, Kaplan–Meier survival methods, Cox proportional hazards regression models Cox proportional hazards regression models: Model 1: adjusted for age, gender and race Model 2: adjusted for Model 1 + diabetes, cardiovascular disease, hypertension, systolic blood pressure and S-cholesterol Model 3: adjusted for Model 2 + calculated glomerular filtration rate	track time: 13.2years IR per 100000 person-years of CKD (95% CI): 98.7(81.3–119.9) RRs for CKD: (95% CI) Model 3: Physical activity: (1.2(0.7-2.0), 2.2(1.2-4.1)) Smoking: (0.8(0.5-1.2), 0.9(0.5-1.9), 2.6(1.4-4.7)) Alcohol consumption: (0.5(0.3-1.0), 0.9(0.6-1.3), 0.9(0.4-2.2)) Body mass index: (1.0(0.2-3.8), 0.7(0.4-1.3), 0.7(0.4-1.4), 1.7(0.6-4.5)) RRs for diabetic or hypertensive nephropathy: (95% CI) Model 3: Physical activity: (3.7(1.0-14.2), 10.1(2.5-41.8)) Smoking: (0.5(0.2-1.5), 0.9(0.2-4.5), 1.4(0.3-7.4)) Alcohol consumption: (0.4(0.1-2.4), 0.5(0.2-1.8), 0.4(0.1-1.8)) Body mass index: (1.0(0.3-3.6), 0.9(0.2-3.1), 2.0(0.3-13.9))
Chen/ 2013	Cross-Sectional	China/ community survey	1834/ ≧18/ 63	Central obesity: waist-to-height ratio≧0.5	estimated glomerular filtration rate(eGFR)<60 ml/min/1.73m^2; or albuminuria-to-creatinine ratio(ACR)>30mg/g	age, gender, hypertension, diabetes, stroke, coronary heart disease, physical inactivity, smoking, alcohol use, education attainment, other MetS components (fasting glucose, serum triglyceride, serum high density lipoprotein, systolic blood pressure and diastolic blood pressure), BMI and waist	Multivariable logistic regressions, Kruskal–Wallis test, one-way Analysis of variance, Chi-squared test, Fisher’s exact test Multinomial logistic regression models: Model 1: unadjusted Model 2: adjusted for age and gender Model 3: adjusted for age, gender, diabetes, stroke, coronary heart disease, physical inactivity, smoking, alcohol use and education attainment Model 4: adjusted for Model 3 + other MetS components	RR for CKD: (95% CI) Model 4: Centrally obese with a high CRP level: 1.68(1.03-2.75) Odds Ratio: (95% CI) Model 3: Waist-to-height Ratio: 1.38(1.15-1.66) Waist circumference: 1.31(1.09-1.57) Body mass index: 1.24(1.05-1.47) p for trend <0.05
Sarathy/ 2016	Cross-Sectional	U.S./ NHANES 1999-2010	6918/ 20-40/ 54	abdominal obesity: waist circumference ≧102 cm in males and ≧88 cm in females	albuminuria ≧30 mg/g	age, gender, race, per-capita income ratio, smoking, BMI, systolic blood pressure, diastolic blood pressure, hypertension, hemoglobin A1C, total cholesterol, HDL, C-reactive protein levels, triglycerides, LDL, glucose, Insulin and diabetes	Student’s t-test for continuous variables, Chi-square tests for categorical variables, Multivariable logistic regression Models adjusted for age, gender, income ratio, smoking status, survey year, and systolic blood pressure, total cholesterol, HDL, hemoglobin A1C, and C-reactive protein levels	Abdominal obesity’s prevalence: Non-Hispanic whites: 37.4% Non-Hispanic blacks: 45.4% Mexican-Americans: 40.6% Odds Ratio: (95% CI) Non-Hispanic White: Albuminuria: 1.1(0.4-2.9) Sex-specified Albuminuria: 1.2(0.6-2.7) Non-Hispanic Black: Albuminuria: 0.4(0.1-1.2) Sex-specified Albuminuria: 0.2(0.1-0.9) Mexican-American: Albuminuria: 4.5(1.6-12.2) Sex-specified Albuminuria: 2.6(1.0-6.5) p for trend <0.05
Bae/ 2021	Cohort	Korea/ NHIS 2009-2016	3030884/ 20-39/ 33	underweight (BMI<18.5 kg/m^2), normal (18.5≦BMI<23), overweight (23≦BMI<25), stage 1 obesity (25≦BMI<30), and stage 2 obesity (≧30) Abdominal obesity: waist circumference ≥90 cm in men and ≥85 cm in women	estimated glomerular filtration rate(eGFR)<60 ml/min/1.73m^2	age, sex, smoking, alcohol drinking, regular exercise, income, glomerular filtration rate, hypertension, diabetes mellitus, dyslipidemia, BMI, WC	Cox proportional hazard models, Kaplan–Meier survival methods Model 1: non-adjusted Model 2: adjusted for age, sex Model 3: adjusted for model 2 + smoking, alcohol drinking, regular exercise, income Model 4: adjusted for model 3 + glomerular filtration rate, hypertension, diabetes mellitus, dyslipidemia	Model 4: HR: (95% CI) obesity(≧25): 1.323(1.250-1.400) abdominal obesity: 1.208(1.132-1.290) OR: (95% CI) only obesity: 1.318(1.232-1.409) obesity within the abdominal obesity: 1.339(1.247-1.438) correlation value between BMI and WC: 0.81441 p for trend <0.05

Abbreviation: IR, incidence rate; CKD, chronic kidney disease; RR, relative risk; CI, confidence interval; BMI, body mass index; OR, odds ratio; HR, hazard ratio; WC, waist circumference; CRP, C-Reactive protein; HDL, high-density lipoprotein; LDL, low-density lipoprotein.

- The risk of CKD was related to race, physical inactivity, smoking, diabetes and hypertension.
- People with obesity and abdominal obesity showed a higher CKD risk. In the CKD risk by obesity composite, abdominal obesity showed the highest CKD risk, especially in young people. We should design a health education for young people to promote their health literacy.
- In Korean’s study, obesity and abdominal obesity were associated with decreased risk in young adults with diabetes. The result was different from our perception. Therefore, it needed to do more research to verify.
- Measures of central obesity, defined by waist circumference or the waist-hip ratio, may be regarded as more effective markers for assessing CKD than BMI.

Conclusion

- Obesity and central obesity were associated with increased risk of chronic kidney disease. Association between obesity and the risk of chronic kidney disease became an important issue in the world. Studying the association between obesity and chronic kidney disease could help prevent the disease. However, in the future, I will continue this study to research the confounding factors between obesity and chronic kidney disease by using 2004-2008 Nutrition and Health Survey in Taiwan (NAHSIT) data.