高雄醫學大學附設中和紀念醫院
Kaohsiung Medical University Chung-Ho Memorial Hospital

慢性腎臟疾病(CKD)患者熱量及蛋白質攝取狀況與腎功能變化之相關性-高醫之經驗

營 養 師：陳梅恩
指導老師: 洪啟智、黃尚志、黃孟娟

2010年06月10日

Presentation outlines

- Background
  - Relation between dietary protein/energy and progression of chronic kidney disease (CKD)
- To know the status of energy and protein intake in CKD patients.
- To know the associations between inadequate energy and excess protein intake and renal functions in a cross-sectional setting.
  - *Huang MC and Chen ME et al, J Ren Nutr (2008)*
- To examine relations between energy and protein adequacy and renal function in a prospective study.
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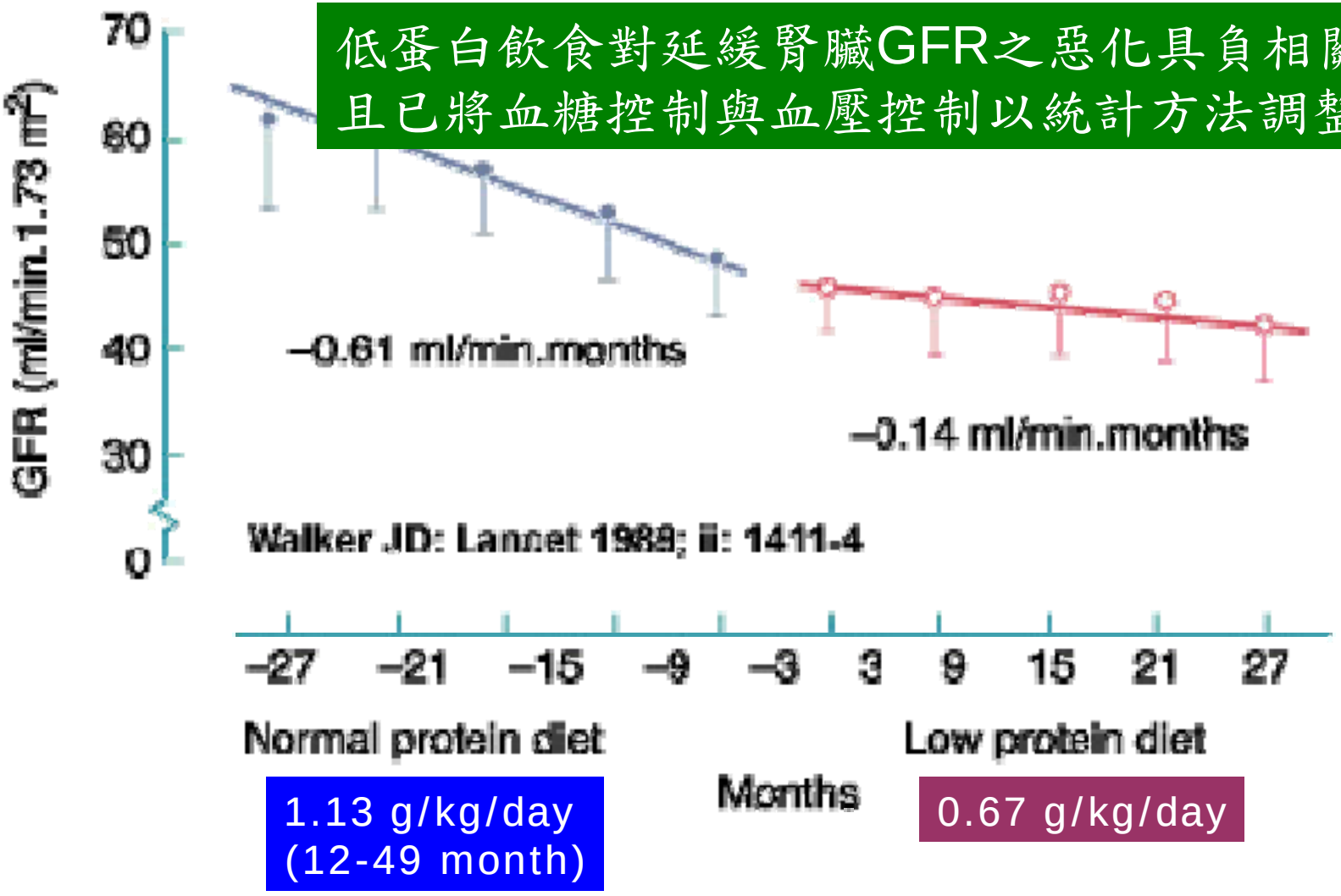
Factors Associated with Loss of Kidney Function in CKD

- Slow the progression of kidney disease
  - Have been proven to be effective
    - Strict glucose control in diabetes
    - Strict blood pressure control
    - ACEI or ARB (microalbuminuria)
    - **Dietary protein restriction**
    - Lipid-lowering therapy
    - Partial correction of anemia

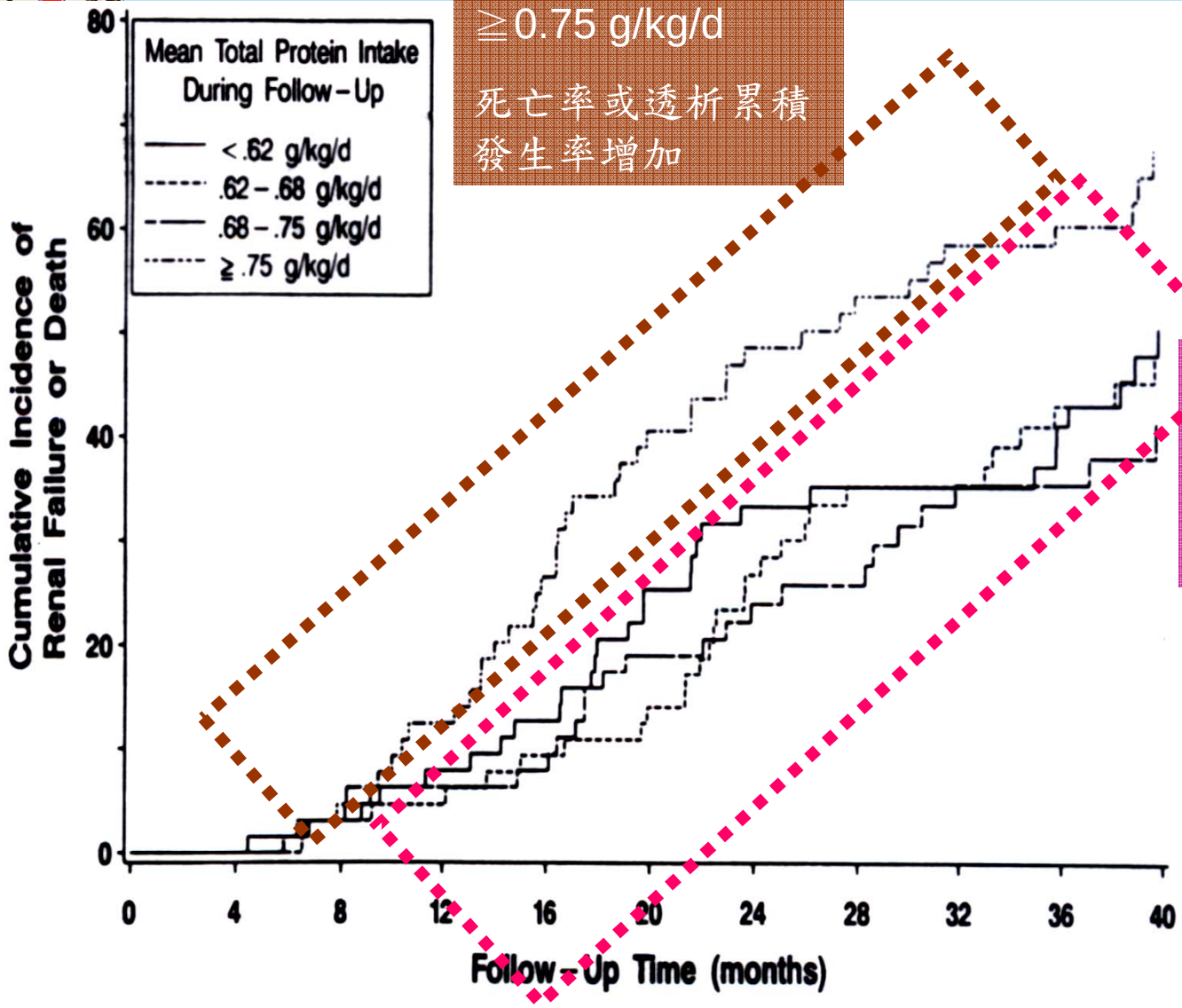
Dietary protein and the Progression of CKD (Diabetic Nephropathy, n=19)

低蛋白飲食對延緩腎臟GFR之惡化具負相關
且已將血糖控制與血壓控制以統計方法調整



Protein intake
≧0.75 g/kg/d

死亡率或透析累積發生率增加

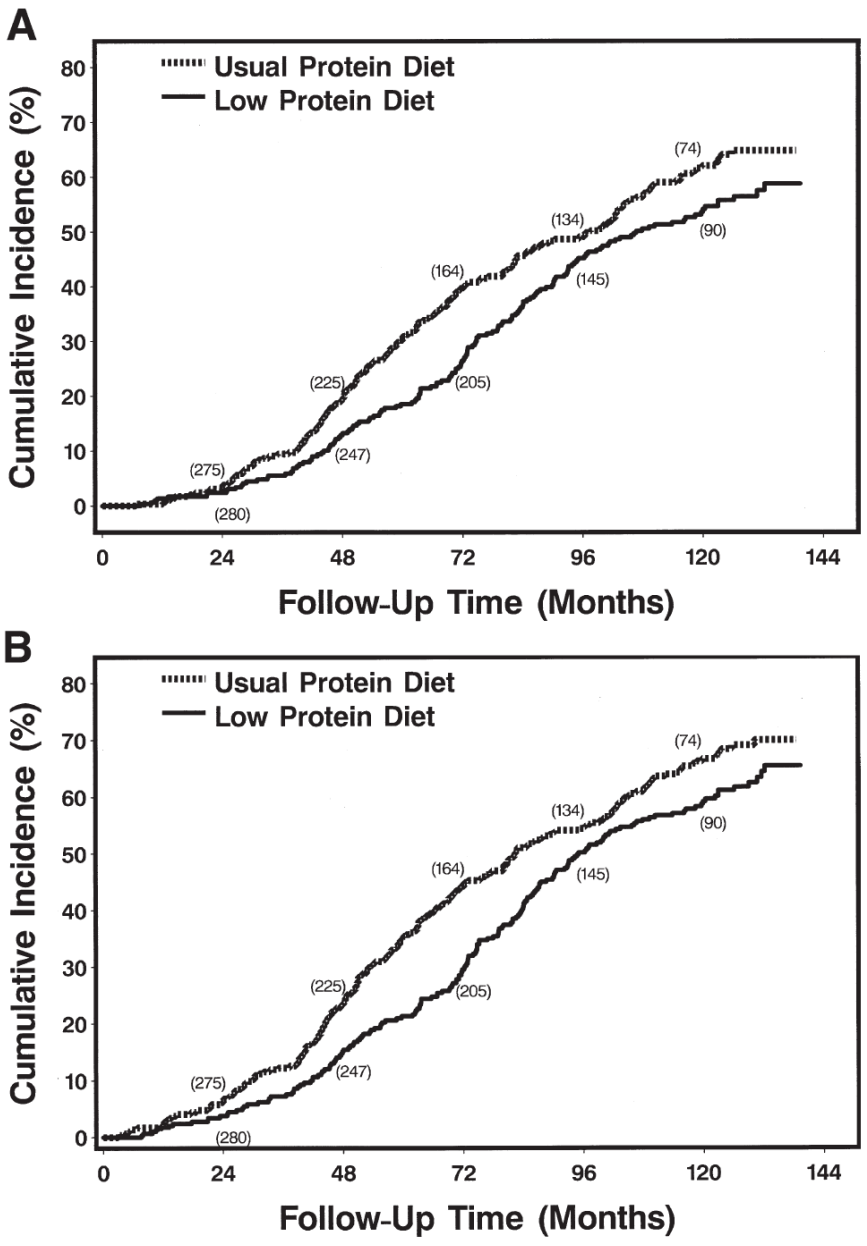


Protein intake
< 0.62-0.75 g/kg/d

死亡率或透析累積發生率較低

Fig 3. Relationship of achieved protein intake to the risk of renal failure or death. Each curve is the cumulative incidence of renal failure or death for subgroups of patients with different values for follow-up total protein intake.

AJKD Vol 27, No5 (May), 1996:652-663



Usual protein diet:1.3g/kg/d
Low protein diet:0.58g/kg/d

A: Kidney failure
B: Kidney failure and all-cause mortality

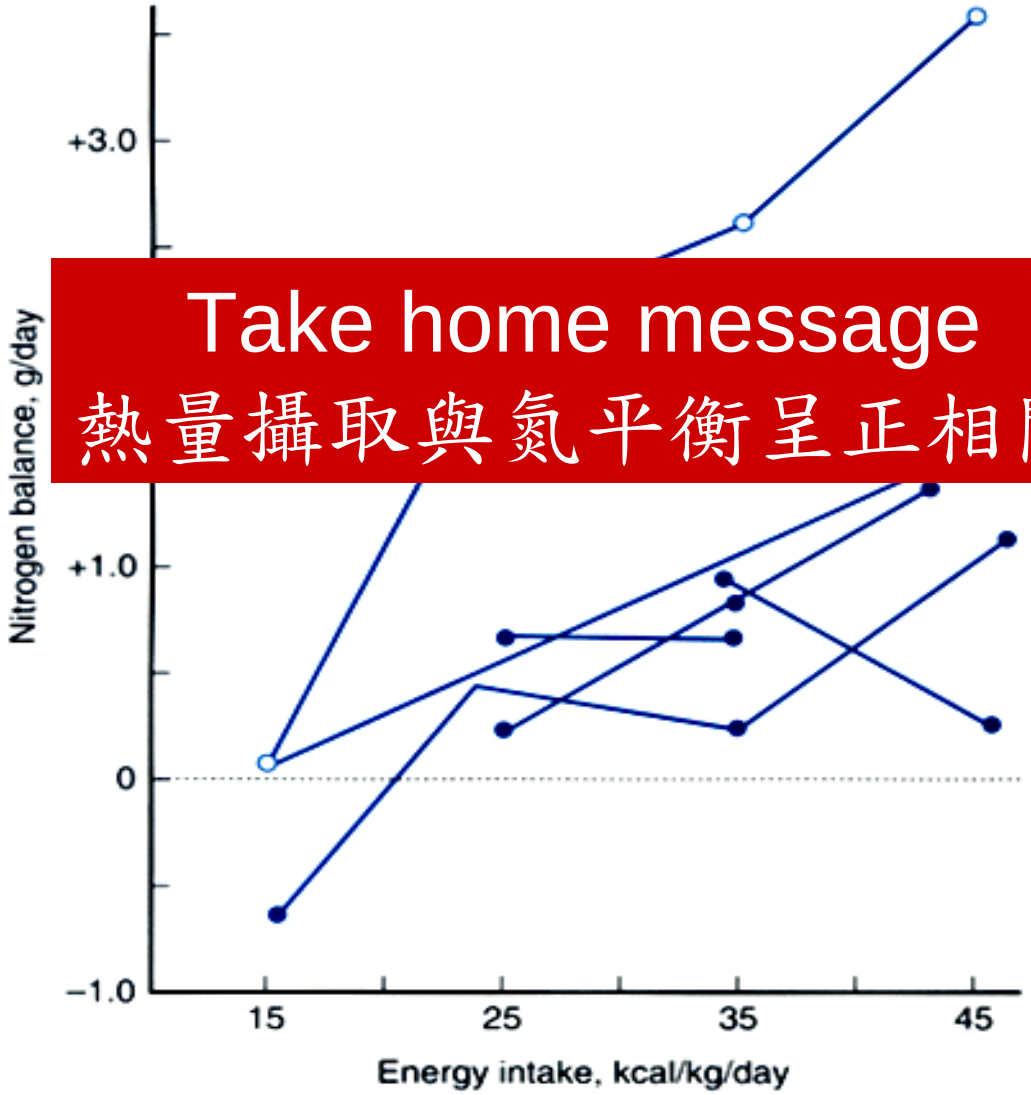
Fig 2. Cumulative incidence of (A) kidney failure and (B) the composite of kidney failure and all-cause mortality before kidney failure. Low- and usual-protein intake refer to target protein intake of 0.58 and 1.3 g/kg/d, respectively. For the outcome of kidney failure, patients who died before kidney failure are censored; therefore, the number of patients at risk for the outcome of (A) kidney failure and (B) the composite of kidney failure and all-cause mortality before kidney failure are the same.

AJKD, Vol 48, No 6(December), 2006: pp 879-888

Importance of energy intake in maintaining nutrition status in non-dialyzed patients

- protein-sparing action (節省蛋白質作用)
  - 熱量足夠可確保蛋白質不被分解
  - 蛋白質- > 葡萄糖 (Gluconeogenesis) ↓
  - insulin：↑anabolism (↑同化作用)
- nonessential amino acid synthesis
  - amino acid→ peptide requires energy

Adequate energy intake correlate with N-balance



Take home message

熱量攝取與氮平衡呈正相關

Figure 57-4 Correlation between nitrogen balance and energy intake in six clinically stable, nondialyzed, chronically uremic patients. *(From Kopple JD, Monteon FJ, Shaib JK: Effect of energy intake on nitrogen metabolism in nondialyzed patients with chronic renal failure. Kidney Int 29:734–742, 1986)*

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Dietary protein /energy intake for nondialysis patients

- K/DOQI
- **Protein requirement** for CKD
  - GFR＜30 ml/min/1.73m^2 (Stage 4-5)
    - 0.6 -0.75 g/kg/day
    - 50% HBV
  - GFR≧30 ml/min/1.73m^2 (Stage 1-3)
    - 0.75 g/kg/day
    - Normal adults RDA
- **Energy requirement** for CKD
  - ＜60 year: 35 kcal/kg/d
  - ≧60 year: 30~35 kcal/kg/d

(AJKD Vol 35,No 6,Suppl 2, June 2000)

ORIGINAL RESEARCH

Inadequate Energy and Excess Protein Intakes May Be Associated With Worsening Renal Function in Chronic Kidney Disease

Meng-Chuan Huang, RD, PhD,★† *Mei-En Chen, MS, RD,*★ *Hsin-Chia Hung, PhD,*‡ *Hung-Chun Chen, MD, PhD,*§ *Wen-Tsan Chang, MD,*‖ *Chien-Hung Lee, PhD,*¶ *Yueh-Ying Wu, MS, RD,*★ *Hung-Che Chiang, MD, PhD,*† *and Shang-Jyh Hwang, MD*§

Journal of Renal Nutrition, Vol 18, No 2 (March), 2008: pp 187–194

The status of energy and protein intake in CKD patients in KMUH

Table 2. Comparisons Between Actual Energy/Protein Intake and Recommended Levels Among CKD Patients (n = 599)

Variables	Intake and Recommended Amounts*	Actual Intakes: Recommended Amounts	*P*
Energy	kcal/day	kcal/day	
Intake	1595.3 ± 511.3		
Recommendation by dietitians	1802.5 ± 216.0	−207.3 ± 481.4	<.001
Recommendation by K/DOQI guideline†	1823.1 ± 240.0	−227.8 ± 489.0	<.001
Protein	g/day	g/day	
Intake	56.7 ± 25.4		
Recommendation by dietitians	44.5 ± 8.7	12.2 ± 24.7	<.001
Recommendation by K/DOQI guideline‡	33.9 to 42.4		

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Aims

- To investigate the relationship between energy/protein intake status and renal function in CKD in KMUH

Definition of protein/energy variables

- Energy and protein intake assessment by RD
  - using 24-h dietary recall
- Energy and protein compliance
  - actual intake (patients) / recommended intake (RD's prescription) X 100%
- Classification of energy and protein intake adequacy
  - High intake: >110%,
  - Moderate: 90% -110%
  - Low intake:<90%

Relationships Between Energy/Protein Intakes and GFR Among CKD Patients using multiple linear regression

Table 4. Multiple Linear Regression Analysis of Relationships Between Energy/Protein Intakes and Renal Function Status Among Chronic Kidney Disease Patients (n = 599)*†

	GFR (mL/min/1.73 m^2)					
	Model 1 (R^2 = 0.107)		Model 2 (R^2 = 0.091)		Model 3 (R^2 = 0.118)	
	β	*P*	β	*P*	β	*P*
Age	−0.12	.001	−0.14	<.001	−0.13	<.001
Sex	−5.02	<.001	−5.75	<.001	−4.90	<.001
Body mass index	0.45	.001	0.39	.007	0.39	.007
Low caloric intake vs. moderate/high intake	−4.28	<.001			−4.41	.008
High protein intake vs. moderate/low intake			−3.24	.015	−3.50	<.001

- **Low energy intake** was significantly related to **worsening of GFR** compared with moderate and high energy intake (P<0.01)
- **high protein intake** was also associated with **worsening of GFR** compared with moderate and low protein intake (P<0.01)

Relationships Between Energy/Protein Intakes and BUN/Creatinine Among CKD Patients using multiple linear regression

	Creatinine (mg/dL)					
	Model 4 (R^2 = 0.063)		Model 5 (R^2 = 0.048)		Model 6 (R^2 = 0.090)	
	β	*P*	β	*P*	β	*P*
Age	−0.03	<.001	−0.02	.003	−0.03	.001
Sex	−0.08	.730	0.11	.633	−0.12	.602
Body mass index	−0.05	.122	−0.03	.399	−0.03	.405
Low caloric intake vs. moderate/high intake	1.12	<.001			1.16	<.001
H						

Low energy intake and high protein intake were significantly positively correlated with **elevations in creatinine and BUN**.

	β	*P*	β	*P*	β	*P*
Age	−0.05	.556	−0.001	.989	−0.02	.814
Sex	4.63	.043	5.82	.009	4.24	.060
Body mass index	−0.48	.118	−0.27	.390	−0.26	.396
Low caloric intake vs. moderate/high intake	7.77	.001			8.20	<.001
High protein intake vs. moderate/low intake			11.29	<.001	11.77	<.001

Conclusion

- Lower energy and higher protein intakes than recommended may be associated with deteriorating renal function.

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Compliance of energy and protein intake correlates with progression of renal functions in patients with chronic kidney disease

Mei-En Chen[1] , Shang-Jyh Hwang[2] , Hung-Chun Chen[2], Meng-Chuan Huang[1,3].

[1]Department of Nutrition and Dietetics, [2]Division of Nephrology, Department of Internal Medicine, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan, [3]Department of Public Health, Faculty of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan

Presented at Experimental Biology 2010, Anaheim, Ca, USA

Aim

- This study examined the association between compliance of energy and protein intake and renal function progression in CKD patients in a prospective study in KMUH.
  - The primary end point evaluation was renal organ death (dialysis).

Methods-Subjects and definition

- Subject recruitment
  - 1040 outpatient recruited from clinics of the Department of Nephrology and Nutrition at a university teaching hospital in southern Taiwan
  - between November 2002 and October 2009
  - received clinical and nutrition co-care for a mean of 3.1 years
- Definition of CKD
  - Adult patients diagnosed with CKD stages 1 to 4 were base on guidelines established by Kidney Disease Outcome Quality Initiative (K/DOQI).

Methods-Definition dietary compliance

- Dietary record and classification
  - Daily energy intake (DEI) and protein intake (DPI) were interviewed and recorded by registered dietitians using 24-hour recall method.
  - Excess DPI was defined as the ratio of actual intake/dietitian-recommended intake $\geqq$110%.
  - Inadequate DEI was defined as the ratio of actual intake/dietitian-recommended intake <90%.
  - Dietary compliance group classification was based on excess DPI and inadequate DEI categories and further categorized into four different groups.

Definition dietary compliance

- 4 dietary compliance group classification

Group		Definition
1	Low DPI	actual intake/dietitian-recommended×100 <110%
	Adequate DEI	actual intake/dietitian-recommended×100 ≥ 90%
2	Low DPI	actual intake/dietitian-recommended×100 <110%
	Inadequate DEI	actual intake/dietitian-recommended×100 < 90%
3	Excess DPI	actual intake/dietitian-recommended×100 ≧ 110%
	Adequate DEI	actual intake/dietitian-recommended×100 ≥ 90%
4	Excess DPI	actual intake/dietitian-recommended×100 ≧ 110%
	Inadequate DEI	actual intake/dietitian-recommended×100 < 90%

Methods-Statistical analysis

- Survival analysis was performed to examine the association between dietary compliance and renal organ death (dialysis).
- Cox adjusted hazard ratio values for dialysis were estimated by comparing four dietary compliance status, using low DPI/ adequate DEI as reference.
- Statistical analyses were conducted using SPSS 15.0 for Windows (SPSS Inc., Chicago IL).

Table 2. Renal function measures and dietary intake among 4 dietary compliance groups

Clinical parameter	Dietary Compliance				*Test for linear trend*
	Low DPI, Adequate DEI	Low DPI, Inadequate DEI	Excess DPI, Adequate DEI	Excess DPI, Inadequate DEI	
CRP (mg/L)	7.06 ± 20.63	12.43 ± 24.96	11.70 ± 26.76	21.05 ± 35.15	0.010
GFR (mL/min/1.73 m^2)	49.25 ± 25.57	37.62 ± 24.48	43.05 ± 23.48	32.11 ± 16.09	0.001
Cr (mg/dl)	1.73 ± 0.78	2.12 ± 0.83	1.95 ± 0.79	2.36 ± 0.83	<0.001
BUN (mg/dL)	23.79 ± 11.43	30.50 ± 13.67	29.31 ± 13.67	34.98 ± 18.02	<0.001
Daily Energy Intake (kcal/day)	1762.0 ± 275.2	1256.7 ± 302.1	2044.1 ± 417.3	1496.9 ± 247.1	<0.001
Daily Protein Intake (g/day)	52.0 ± 10.1	40.3 ± 11.8	76.8 ± 19.8	60.5 ± 11.6	<0.001
Daily Protein intake (g/Bw/day)	0.77 ± 0.14	0.63 ± 0.17	1.20 ± 0.30	0.97 ± 0.17	<0.001
Dialysis (N/%)	3 (2.1%)	41 (10.3%)	44 (11.2%)	17 (16%)	0.001

[1]Data are expressed as mean±SD or N(%). Test for trend are determined using simple linear regression. *P* <0.05 was considered statistically significant.

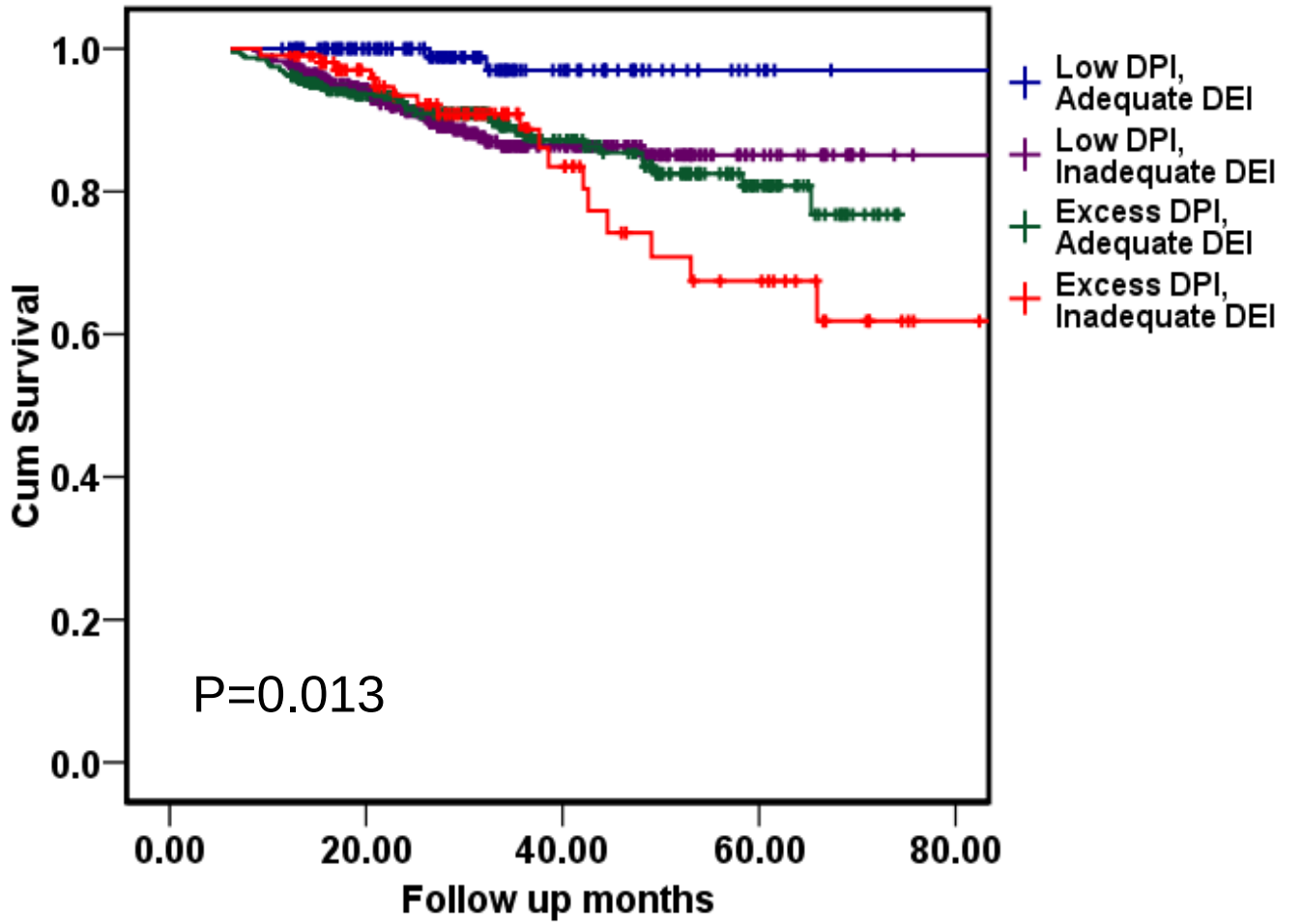


Figure 1.Kaplan-Meier survival curves for four dietary compliance in relations to renal organ death (dialysis) by log-rank test.

Table 3.Cox proportional hazard regression analysis between dietary compliance and risks of renal organ death (dialysis)

	Model 2	
	Adjusted OR (95%CI)	*p*
Age	1.911(1.271-2.873)	0.002
Sex	1.494(0.976-2.286)	0.064
BMI	1.226(0.629-2.390)	0.551
Albumin	3.492(2.368-5.148)	<0.001
CKD stage	-	-
Low DPI, Adequate DEI	1	
Low DPI, Inadequate DEI	4.690(1.447-15.205)	0.010
Excess DPI, Adequate DEI	4.539(1.405-14.659)	0.011
Excess DPI, Inadequate DEI	6.100(1.782-20.880)	0.004

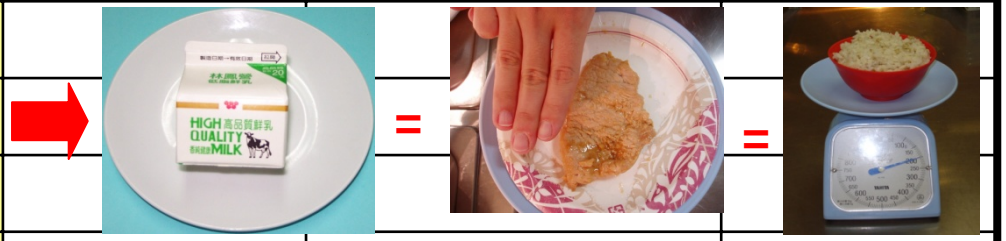
Model 2: adjusted for age, sex, BMI, and albumin.

Conclusion from the two investigation

- In a cross-sectional setting or prospective study, we demonstrated dietary energy and protein compliance correlate with renal function worsening.
- Intensive nutrition counseling needs to be initiated after CKD diagnosis in order to prevent further worsening of renal function.

加強含蛋白質食物的份量概念

六大類食物		蛋白質(公克)	脂肪(公克)	碳水化合物(公克)	熱量(大卡)
奶類	全脂	8	8	12	150
	低脂	8	4	12	120
	脫脂	8	-	12	80
肉魚豆蛋	高脂	7			
	中脂	7			
	低脂	7			
五穀根莖	米食	1.5	-	15	66
	麵食	2.2	-	15	68.8
蔬菜		1	-	5	24
油脂			5	-	45
水果			-	15	60



以低蛋白食物增加熱量攝取

低蛋白點心目錄

慢性腎臟病如何吃

低蛋白質飲食

爲何要限制蛋白質?

減少蛋白質攝取，可減少含氮廢物產生，減少腎臟負擔，延緩腎臟功能的衰退。

如何限制蛋白質？

* 選擇適量的高生理價動物性蛋白質，如：蛋、奶類、肉、魚類及黃豆製品。
* 減少植物性蛋白質如：麵、米、根莖類。
* 避免豆類、麵筋類、堅果類。
* 增加純澱粉（低氮澱粉類）、純糖類及植物油，以提供足夠熱量。若熱量攝取不足，會引起身體蛋白質的分解，加重腎臟負荷，使腎臟惡化速度加快。

慢性腎臟病如何吃

選擇低蛋白食物

低氮澱粉

冬粉、粉皮、澄粉、粉板、西谷米、太白粉、玉米粉、藕粉、蕃薯粉、蕃薯粉製品（如：粉條、QQ圓、蕃薯圓、藕圓）、糖餡、益富益補、粉餡、麥芽糊精、低蛋白煎餅粉、低蛋白蛋糕粉、低蛋白米粒、低蛋白麵條。

純糖類

白糖、果糖、蜂蜜、水果糖、薑糖、果醬。

植物油

芥花油、葵花油、玉米油、大豆油、橄欖油…

低蛋白配方

腎補納(Suplena)、三多低蛋白配方(LPF)需由營養師指導使用。

低氮澱粉圖例

低氮澱粉、純糖類、植物油、低蛋白配方

Future study

- To develop nutrition education tools in KMUH (food serving models).
- To reinforce important of energy adequacy and protein restriction in slowing progression of renal function in CKD patient.
- To conduct intervention trials to compare efficacy of different education tools. Improving patients' perception in quantifying energy and protein from foods.

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敬請指教