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Psychological stress as a risk factor for renal function decline

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Objectives:

Accumulating evidences propose that psychological stress leads to changes in biological processes or behavioral patterns that effects disease risks. Supporting this possibility, recent animal experiments and population studies show a probable link between psychological stress and cardiovascular and metabolic diseases. However, the association between psychological stress and kidney function is not well elucidated yet.

Methods:

Data were retrieved from a prospective community-based cohort study (Korean Genome and Epidemiology Study). Psychological distress was assessed as the primary exposure using PWI-SF (psychosocial well-being index short form) scores. The decline rate of estimated glomerular filtration rate (eGFR) over time was calculated using linear regression analysis of serial eGFR measurements for each subject. Rapid eGFR decline was defined as an average decline in eGFR ≥ 3 ml/min/1.73 m² per year.

Results:

In total, 6,968 participants were analyzed. During a median follow-up of 10.49 years, rapid eGFR decline was observed in 886 (12.7%) participants. When the participants were categorized into tertiles according to PWI-SF score, rapid eGFR decline was more prevalent in the highest PWI-SF score group (14.0%) compared to the lowest PWI-SF score group (11.1%). Multivariate logistic regression analyses revealed that the risk of rapid eGFR decline was significantly increased in the highest PWI-SF score group compared to the lowest group (odds ratio, 2.04; 95% confidence interval 1.27-3.27). When PWI-SF score was treated as a continuous variable, each 1 standard deviation increase in PWI-SF was associated with a 12% increased risk of rapid eGFR decline.

Conclusions:

The amount of psychological stress was significantly associated with an increased risk of rapid renal function decline in participants with normal renal function.

Figure 1. Baseline characteristics between groups assorted by the level of psychological distress

Table 1. Baseline characteristics between groups assorted by the level of psychological distress

	Total (n=6968)	PWI groups			P
		Healthy group (n=3992)	Potentially stressful group (n=2866)	High-risk group (n=110)	
Male (%)	3384 (48.6)	2148 (53.8)	1205 (42.0)	31 (28.2)	<0.001
Age (y)	52.20 ± 8.83	52.17 ± 8.70	52.02 ± 8.95	57.87 ± 8.59	<0.001
Educational attainments lower than high school graduates (%)	5979 (85.8)	3335 (83.5)	2540 (88.6)	104 (94.5)	<0.001
Income groups					<0.001
High income (%)	137 (2.0)	98 (2.5)	39 (1.4)	0 (0.0)	
Middle income (%)	2364 (33.9)	1423 (35.6)	928 (32.4)	13 (11.8)	
Low income (%)	4467 (64.1)	2471 (61.9)	1899 (66.3)	97 (70.5)	
Married (%)	6289 (90.3)	3637 (91.1)	2563 (89.4)	89 (80.9)	<0.001
BMI (kg/m²)	24.60 ± 3.13	24.73 ± 3.07	24.44 ± 3.18	24.22 ± 3.89	<0.001
History of alcohol ingestion					<0.001
None (%)	3197 (45.9)	1758 (44.0)	1368 (47.7)	71 (64.5)	
Past drinker (%)	413 (5.9)	264 (6.6)	143 (5.0)	6 (5.5)	
Current drinker (%)	3358 (48.2)	1970 (49.3)	1355 (47.3)	33 (30.0)	
History of smoking					<0.001
None (%)	4110 (59.0)	2268 (56.8)	1769 (61.7)	73 (66.4)	
Past smoker (%)	1139 (16.3)	752 (18.8)	374 (13.0)	13 (11.8)	
Current smoker (%)	1719 (24.7)	972 (24.3)	723 (25.2)	24 (21.8)	
Hypertension (%)	1087 (15.6)	591 (14.8)	466 (16.3)	30 (17.2)	0.001
Diabetes mellitus (%)	447 (6.4)	239 (6.0)	197 (6.9)	11 (10.0)	0.101
Cerebrovascular accident (%)	74 (1.1)	33 (0.8)	37 (1.3)	4 (3.6)	0.005
Baseline eGFR (mL/min/1.73 m²)	92.07 ± 14.01	92.09 ± 14.05	92.15 ± 13.98	89.23 ± 13.16	0.099
PWI score	17.27 ± 8.69	11.17 ± 4.92	24.95 ± 4.62	38.71 ± 1.91	<0.001
Rapid decline in renal function	886 (12.7)	443 (11.1)	416 (14.5)	27 (14.0)	<0.001
Hemoglobin (g/dL)	13.62 ± 1.56	13.74 ± 1.56	13.48 ± 1.55	13.14 ± 1.41	<0.001
Total cholesterol (mg/dL)	191.04 ± 34.93	190.85 ± 34.79	191.28 ± 35.19	191.38 ± 33.77	0.877
Serum total protein (mg/dL)	7.30 ± 0.45	7.30 ± 0.44	7.29 ± 0.45	7.23 ± 0.42	0.102
BUN (mg/dL)	13.95 ± 3.71	14.08 ± 3.70	13.77 ± 3.71	14.00 ± 3.90	0.003
Serum sodium (mmol/L)	142.57 ± 2.17	142.58 ± 2.19	142.54 ± 2.15	142.90 ± 2.12	0.213
Serum potassium (mmol/L)	4.49 ± 0.41	4.51 ± 0.42	4.47 ± 0.39	4.51 ± 0.50	<0.001

Note: Data are expressed as either mean ± standard deviations or numbers (%), except where noted.

It is defined as rapid decline in renal function if the annual decrease in eGFR of a subject is above -3 mL/min/1.73 m².

Income groups are sorted according to classification criteria made by OECD; high income as an income level above 150% of a median income of a population, low income as an income level below 50% of a median income, and middle income as the rest.

PWI groups are sorted as follows; PWI score of more than 27 as high-risk group, PWI score of less than 8 as healthy group, and the rest as potentially stressful group.

Abbreviations: eGFR, estimated glomerular filtration rate; BMI, body mass index; PWI, psychosocial well-being index; OECD, Organization for Economic Cooperation and Development.

Figure 2. Multivariate logistic regression analysis of association between psychosocial well-being index and rapid renal function decline

Table 2. Multivariate logistic regression analysis of association between psychosocial well-being index and rapid renal function decline

		Model 1		
		OR	95% CI	P value
PWI score		1.016	1.008-1.024	<0.001
PWI score/S.D.		1.150	1.072-1.233	<0.001
PWI group				
Healthy group (36⁻)		Reference		
Potentially stressful group		1.360	1.179-1.570	<0.001
High-risk group (⁻19)		2.606	1.670-4.068	<0.001

	Model 2			Model 3			Model 4			Model 5		
	OR	95% CI	P value	OR	95% CI	P value	OR	95% CI	P value	OR	95% CI	P value
PWI score	1.016	1.008-1.024	<0.001	1.015	1.006-1.023	<0.001	1.013	1.004-1.021	0.003	1.013	1.005-1.022	0.002
PWI score/S.D.	1.147	1.068-1.231	<0.001	1.137	1.058-1.221	<0.001	1.117	1.039-1.201	0.003	1.120	1.041-1.205	0.002
PWI group												
Healthy group (36⁻)	Reference			Reference			Reference			Reference		
Potentially stressful group	1.373	1.183-1.594	<0.001	1.354	1.166-1.573	<0.001	1.328	1.142-1.544	<0.001	1.330	1.143-1.548	<0.001
High-risk group (⁻19)	2.145	1.345-3.420	0.001	2.065	1.293-3.297	0.002	1.977	1.233-3.171	0.005	2.036	1.269-3.266	0.003

Note:

Model 1: non-adjusted model

Model 2: adjusted for age, sex, baseline eGFR

Model 3: Model 2 plus BMI, education group, income groups, marital status, smoking, alcohol ingestion

Model 4: Model 3 plus HTN, DM, CVA

Model 5: Model 4 plus hemoglobin, total cholesterol, serum total protein, BUN, serum sodium, serum potassium

Abbreviations: PWI, psychosocial well-being index; S.D., standard deviation; eGFR, estimated glomerular filtration rate; BMI, body mass index; HTN, hypertension; DM, diabetes mellitus; CVA, cerebrovascular accident; BUN, blood urea nitrogen; OR, odds ratio; CI, confidence interval.