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Decrease of Kidney Function in Manufacture Industry Workers in West Java in 2022 and the Relationship with Individual and Occupational Risk Factors

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Abstract

Background: The incidence of chronic kidney disease is increasing with a fairly high annual death rate which is a serious health problem in the world because it has increased incidence, has an impact on morbidity and mortality as well as a serious socio-economic world including in Indonesia with the majority of the working age population in the manufacturing industry. Therefor an early detection of decreased kidney function and factors that influence it become necessity.
Methods: This research is analytical quantitative research with a cross-sectional design using secondary data of MCU in Occupational Health and Safety Service Company in 2022 with total 2,304 data. The data includes of eGFR as dependent variable and individual risk factors, history of illness risk factors, clinical risk factors and occupational risk factors as independent variable.
Result: The results of the study suggest there was a decrease in kidney function (Glomerular Filtration Rate / GFR <90 ml/minute/1.73m2) of 33,8% of the total manufacturing industry workers in West Java in 2022. The decrease of eGFR is influenced by individual, clinical and occupational risk factors.
Conclusion: The conclusion, risk factors that influence the incidence of decreased renal function in manufacture industry workers in West Java in 2022 are male, age over 40 years old, conditions of grade I and II hypertension, obesity and periodes of work of more than 19 years, with the most dominant influence factor is male gender.
Keywords: chronic, kidney, disease,occupational, risk factors, manufacturing industry

Abstrak

Latar belakang: *Angka kejadian penyakit ginjal kronik yang meningkat dengan tingkat kematian tinggi menjadi masalah kesehatan serius di dunia, berdampak pada morbiditas dan mortalitas serta sosial ekonomi serius dunia termasuk di Indonesia dengan mayoritas penduduk usia angkatan kerja pada industri manufaktur. Oleh karena itu diperlukan deteksi dini penurunan fungsi ginjal dan faktor yang mempengaruhinya.*
Metode: *Penelitian potong lintang analitik dengan pendekatan kuantitatif menggunakan data sekunder MCU PJK3 tahun 2022 dengan total data penelitian sebanyak 2304 data. Data terdiri dari eLFG sebagai variabel terikat dan faktor risiko individu, riwayat penyakit, risiko klinis, risiko pekerjaan sebagai variabel bebas.*
Hasil: *Terjadi penurunan fungsi ginjal (Laju Filtrasi Glomerolus /LFG <90 ml/menit/1.73m^2) sebesar 33,8% dari total pekerja industri manufaktur di Jawa Barat pada tahun 2022. Penurunan eLFG dipengaruhi oleh faktor resiko individu, klinis dan pekerjaan.*
Kesimpulan: *Faktor risiko yang berpengaruh terhadap kejadian penurunan fungsi ginjal pada pekerja Industri Manufaktur di Jawa Barat pada 2022 adalah jenis kelamin laki-laki, usia lebih dari 40 tahun, kondisi hipertensi derajat I dan II, obesitas dan masa kerja lebih dari 19 tahun, dengan faktor berpengaruh yang paling dominan adalah jenis kelamin laki-laki.*
Kata kunci: *penyakit ginjal kronis, eLFG, faktor risiko, industri manufaktur*

Introduction

Chronic kidney disease is one of the non-communicable diseases which is a serious health problem in the world because it has increased incidence, has an impact on morbidity and mortality as well as socio-economic conditions. Global prevalence continues to increase every year. The results of the 2010 Global Burden of Disease study, chronic kidney disease was the 27th leading cause of death in the world in 1990 and increased to 18th in 2010. More than 2 million people worldwide receive treatment with dialysis or kidney transplantation and only about 10% who actually experienced the treatment. 10% of the world's population suffer from chronic kidney failure and millions died every year because they do not have access to treatment.[1]

The National Kidney Foundation (2018) has reported that 10% of the world's population has CRF.[2] While the results of the 2022 Indonesian Nephrology Association Community (PERNEFRI) survey of 9,412 subjects in Indonesia show that 12.5% have experienced decreased kidney function. This means that around 25-30 million Indonesians have decreased kidney function. However, the data on the age distribution of the subjects were not explained.[1] In the occupational sector, Indrawati (2015) found prevalence 17% of hot press section of shoe factory workers have decreased of kidney function.[3]

Gallo Ruiz stated that his research, which suggested that heat exposure in the workplace was a risk factor for kidney illness in Nicaragua, also discovered that brick workers had a high prevalence of chronic kidney disease.[4] Kidney issues originally became a significant concern for migrant laborers. For instance, a study using hospital data on 44 migrant workers from Nepal who were receiving treatment for chronic kidney disease discovered that 70.5% of the patients had worked manual or semi-manual labor in Malaysia and the Gulf countries, 70% had worked more than 60 hours per week, and up to 77.3% of the patients' causes were unknown. According to a long-term research involving 65 Indian construction workers, 18% of them had renal illness. Studies indicate that exposure to heat, prolonged work, dehydration, sleep deprivation, and obesity are associated with an increased risk of renal disease. Eighteen percent of chronic kidney disease patients in Indonesia were formerly migrant laborers. The use of soft drinks, alcohol, and bad eating habits were found to be risk factors for chronic kidney disease in a qualitative study of migrant workers from Indonesia. 15% of workers who work in extremely hot workplaces have kidney issues, according to systematic observations.[5]

Manufacturing industry sector was the main pillar of national economic growth in 2022,[6] and West Java is a province that has the most industrial areas and the largest industrial land area in Indonesia,[7] this is the basis for researchers to conduct research analysis on the manufacturing sector in the West Java region. Approximately 52% of Indonesia's population are labor force, and with the trend of increasing the number of chronic kidney disease cases from year to year, coupled with the high annual mortality rate of people with chronic kidney disease, early detection of kidney disease must be carried out as early as possible, so it can be detected as soon as possible before the decreased in kidney function is getting worse, causing symptoms or clinical manifestations in this case, especially for workers (who have access to regular routine health checks from the company where they work). The main objective to achieve is to maintain worker's productivity.

Methods

This research was an analytical cross-sectional study with a quantitative approach using secondary data from manufactory workers that underwent annual MCU in Occupational Health and Safety Service Company in 2022. The data obtained was then sorted according to inclusion (all variables needed were filled), and exclusion criteria and then data processing was carried out. Of the 13,892 total data on manufacturing workers in West Java, there are 2,304 data that meet the inclusion criteria. The results of the data processing were then analyzed using the SPSS (Statistical Package for Social Science) program with cut-off eGFR <90 ml/minute/1.73 m^2 and presented in the research results.

The data includes of eGFR as dependent variable and individual risk factors, history of illness risk factors, clinical risk factors and occupational risk factors as independent variable. Variables related to laboratory examination was based on specimen taken from venous blood and mid-stream urine.

Result

A prevalence of decreased kidney function was found in West Java's manufacturing industry workers in 2022, with a percentage of 33.8%, or 779 people out of 2,304 samples examined. It can be described in the following ways:

Characteristic Analysis

Males made up 1,999 (86.8%) of the total population and there were 1,256 (54.5%) people in the over-40 age group. Workers having trouble in urinating were only 13 (0.6%) while workers with urinary tract inflammation were 10 (0.4%). Additionally, there were only 5 (0.2%) workers with history of kidney disease. Workers with bladder stones only 30 (1.3%) and worker with urinary incontinence complain were just 3 (0.1%).

There were 202 employees (8.8%) of the workforce had a history of hypertension while workers with diabetes were 20 (0.9%). Worker consuming alcohol were 20 (0.9%) and smokers were 1,210 (52,5%) of the work forces, additionally there were 520 (22.6%) workers that non-exerciser.

Table 1. Characteristic of occupational risk factor

		n	%
Manufacture type	Food and Drinks	2,202	95.6%
	Others	102	4.4%
Working period > 19 years	No	1,242	53.9%
	Yes	1,059	46.0%
Heat temperature	No	1,665	72.3%
	Yes	639	27.7%
Cold temperature	No	1,752	76.0%
	Yes	552	24.0%
Workload not matched time and amount of work	No	2,148	93.2%
	Yes	156	6.8%
Prolong seating more than 4 hours continuously	No	1,804	78.3%
	Yes	500	21.7%
Unergonomic body position	No	2,097	91.0%
	Yes	207	9.0%

Pre hypertension conditions accounted for the biggest percentage of blood pressure-related worker classifications (1,109; 48.1%), followed by normotension (741; 32.2%), first degree hypertension (324; 14.1%) and second degrees hypertension (130; 5.6%). According to the classification of body mass index, it was discovered that there were 1,145 cases of obesity (49.7%), 640 cases of normal weight (27.8%), 429 cases of overweight (18.6%), and 90 cases of thinness (3.9%).

There were 141 (6.1%) workers with diabetes (DM) and 1,824 workers with abnormal lipid analysis condition and additionally, there were 773 (33.6%) workers with abnormal urinalysis findings and 1,758 workers (76.3%) had metabolic syndrome.

The industry that produced the most data were food and beverage sector, had 2,202 data (95.6%) while 1,059 employees (46.0%) had more than 19 years of service and the other 1,242 employees (53.9%) had less than 19 years.

About 639 (27.7%) of the workers were exposed to heat, whereas 1,665 (72.3%) were not. And 552 employees (24.0%) were exposed to frigid temperatures, compared to 1,752 employees (76.0%) who were not. In additions there were only 156 workers (6.8%) who claimed that the workload did not correspond to the time and amount of work. While those who were exposed to working in non-ergonomic body positions were 207 (9.0%) and those who were exposed to sitting for more than 4 hours straight were 500 (21.7%).

Correlation Analysis

Men are 1.6 times more likely to experience a decreased kidney function, and gender differences are significantly associated with this condition. Age is a crucial factor in the relationship between renal function decline, and individuals over 40 have a 4.1 times higher risk of kidney function decline.

Workers with a history of bladder stones are 1.6 times more likely to experience a decreased kidney function, and the bladder stone variable is strongly connected to such a decline. Individuals who have a history of high blood pressure are 1.5 times more likely to experience a decreased renal function. High blood pressure is a substantial risk factor for decreased kidney function. Workers with a history of diabetes had a 1.4

times higher risk of experiencing a deterioration in kidney function. Diabetes factors are substantially related with impaired kidney function.

The incidence of decreased kidney function is highly correlated with the smoking classification variable however smokers are only 0.2 times more likely than nonsmokers to develop decreased renal function. Workers with prehypertension have a 1.3 times greater chance of decreased kidney function, while those with first-grade hypertension have a 1.9 times greater chance and those with second-grade hypertension have a 2.2 times greater. The blood pressure classification variable is significantly associated with the incidence of decreased kidney function.

Workers with less body weight are significantly associated with the incidence of decreased kidney function, but they are only 0.5 times more likely than workers with normal weight to experience decreased kidney function, according to the body mass index classification variable. Employees who are obese or overweight have a 1.4 times higher likelihood of having decreased kidney function than average-weight employees, and the odds are 1.2 and 1.2 respectively. Workers with aberrant lipid analysis findings had a 1.1 times higher likelihood of declining kidney function, and the lipid analysis variable was substantially related with a decreased renal function.

Workers with aberrant urine analysis findings have a 1.1 times greater likelihood of having lower kidney function, indicating a substantial relationship between the urine analysis variable and kidney function. Kidney function decline is substantially correlated with the analysis variable of metabolic syndrome, and workers with metabolic syndrome had a 1.2-fold higher risk of decreased kidney function.

Food and beverage manufacturers had a 2.8 times higher chance of experiencing a decreased renal function than employees in other manufacturing types, and the kind of manufacturing variable is substantially connected to a decreased kidney function. Worker longevity is substantially associated with a deterioration in kidney function, and those who have worked for more than 19 years are more likely to have a decreased kidney function that is 2.3 times greater than those who have worked for less than 19 years. Although there is a strong correlation between the non-ergonomic body position variable and decreased kidney function, non-ergonomic body position workers are only 0.4 times more likely to have a decreased kidney function than ergonomic body position workers.

Table 2. Correlation of occupational risk factor and decrease of eGFR

		eGFR <90				p Value	OR (CI 95%)
		Yes		No			
		n	%	n	%		
Manufacture type	Food and Drinks	763	34.7%	1,439	65.3%	0.003	2.8 (1.6-4.8)
	Others	16	15.7%	86	84.3%		Ref
Working period > 19 years	No	257	20.7%	985	79.3%	<0.001	Ref
	Yes	520	49.1%	539	50.9%		2.3 (2.0-2.6)
Heat temperature	No	566	34.0%	1,099	66.0%	0.764	
	Yes	213	33.3%	426	66.7%		
Cold temperature	No	606	34.6%	1,146	65.4%	0.159	
	Yes	173	31.3%	379	68.7%		
Workload not matched time and amount of work	No	737	34.3%	1,411	65.7%	0.06	
	Yes	42	26.9%	114	73.1%		
Prolong seating more than 4 hours continuously	No	623	34.5%	1,181	65.5%	0.163	
	Yes	156	31.2%	344	68.8%		
Unergonomic body position	No	727	34.7%	1,370	65.3%	0.006	Ref
	Yes	52	25.1%	155	74.9%		0.6(0.4-0.8)

Multivariate Analysis

With a p value 0.05 and a coefficient of determination (R2) of 0.192, multivariate analysis with logistic regression revealed that male gender, age over 40, first and second grade hypertension, obesity, and length of employment over 19 years were the determinant risk factors related to the decreased in kidney function in this working population. This indicates that there are still 80.8% of additional factors outside of this study that may contribute to the reduction in kidney function, including dehydration, soda drinking habits, and nephrotoxins.

Discussion

There are numerous factors that affect the prevalence of chronic renal failure. The emergence of chronic kidney failure requires a role for risk variables to play together (common underlying risk factor); in other words, one risk factor is not sufficient to produce chronic kidney failure.

The prevalence of decreased kidney function was found in 779 people, namely 33.8%. This is quite large when you see that based on data from Pernefri (2022) the incidence of decreased kidney function reached 12.5% of the Indonesian population and the report of the National Kidney Foundation (2018) the rate of chronic kidney disease is 10% of the world's population.[1] Although there is a difference in subject used by Pernefri and this study, this study using data of healthy group of workers that underwent MCU in 2022 therefore there is possibility both study using different of operational definition.

In the occupational sector, Indrawati (2015) found prevalence 17% of hot press section of shoe factory workers have decreased of kidney function.[3] This could be warning sign for the present of kidney problem in manufactory workers.

Table 3. Correlation and influence of variables and decrease of eGFR

	B	S.E.	Wald	df	Sig.	aOR	aOR CI95%	
							Lower	Upper
Age > 40 years	.909	.139	42.734	1	.000	2.481	1.890	3.259
Male gender	.927	.152	37.060	1	.000	2.528	1.875	3.407
Normal blood pressure			26.072	3	.000			
Prehypertension	.154	.114	1.804	1	.179	1.166	.932	1.459
HT grade 1	.632	.152	17.333	1	.000	1.882	1.398	2.535
HT grade 2	.768	.211	13.200	1	.000	2.156	1.424	3.263
Normal BMI			16.259	3	.001			
Low BMI	-.435	.311	1.960	1	.162	.647	.352	1.190
Overweight	.157	.146	1.157	1	.282	1.170	.879	1.556
Obesity	.386	.118	10.695	1	.001	1.471	1.167	1.855
Working period >19 years	.659	.133	24.535	1	.000	1.933	1.489	2.509
Constant	-2.809	.197	202.620	1	.000	.060		

In line with Sofia Rubinstein and colleagues in their research, they noted that although work is well recognized as a risk factor for chronic kidney disease, epidemiological data that elucidates the intricate connection between occupational risk factors and chronic kidney disease is still scarce. Only exposure to nephrotoxins, such as lead, mercury, glycol ether, organic solvents, asphalt, welding fumes, silicon, and dust, is the subject of the occupational risk factor report.[11]

The food and beverage manufacturing industry found to have the highest incidence of decreased kidney function in this study; this may be because there were more types of this industry represented in the data on workers performing MCU, accounting for 95.5% of the total sample that met the inclusion criteria, or 2,304 samples.

Male sex and age above 40 were revealed in this study to be the two distinct characteristics that affect the incidence of reduced kidney function. According to Farida Arriyani (2023), men and people who are older are at a higher risk for developing chronic renal disease. Additionally, P2PTM Ministry of Health data shows that men (0.3%) have a higher prevalence of patients with kidney failure than do women (0.2%) in Indonesia.[8]

Both gender and age were found to be significant risk factors from the individual risk factor groups based on bivariate analysis, and after multivariate analysis it was also discovered that gender and age had a significant impact on the incidence of decreased kidney function.

The results of bivariate analysis on the risk factors for urinary stones revealed a significant correlation between reduced kidney function and these risk factors. This is consistent with the theory that urinary tract stones may be related to the condition of tubulointerstitial disease, one of the etiologies of chronic kidney disease, even though the number of workers who complain about it is small and subjective.

Bivariate analysis of the risk factors for high blood pressure revealed a significant relationship between kidney function decline and these results are consistent with the theory that high blood pressure can be linked to vascular disease, one of the etiologies of chronic kidney disease.

According to Rivandi (2015), DM conditions can result in micro albuminuria, which can further reduce kidney function, and the findings of the bivariate study on the risk factors for diabetes revealed a strong association between this and lower renal function.[9]

Based on bivariate analysis, it was determined that urinary stones were the only risk factor for history of disease that had a significant relationship with incidence of decreased kidney function. Urinary tract inflammation, kidney disease, urinary incontinence, and history of difficulty urinating did not significantly correlate with the incidence of decreased kidney function. High blood pressure and diabetes were shown to be confounding factors when multivariate analysis revealed that they did not significantly affect the incidence of decreased renal function.

Contrary to Aisyah's (2015) research, which discovered a significant relationship between smoking activity at the start of the day, number of cigarettes, time off, and the incidence of kidney disease, smoking class risk factors obtained from bivariate analysis in the clinical risk factor group revealed a significant relationship with decreased kidney function but with a smaller chance for workers who smoke to experience a decrease in kidney function than workers who do not smoke.[10] This may be the result of the unknown daily cigarette use rate and age (Brinkman index). The company in question can then investigate this further.

The findings of the bivariate analysis showed a substantial correlation between impaired kidney function and the risk factors for BP class and BMI class. According to Joshua Botdorf (2011), despite the difficulty in determining their mutual influence, hypertension and chronic kidney disease (CKD) frequently co-occur. explained. In the United States, hypertension is the second-leading cause of end-stage renal disease (ESRD) after diabetes, and it affects 61-66% of people with an estimated glomerular filtration rate (eGFR) of less than 60 ml/min/1.73 m2.[11]

According to the findings of the bivariate analysis, lower kidney function was significantly related to the risk factors for metabolic syndrome. According to Widyana (2017), the metabolic syndrome can lead to hyperfiltration, which in turn promotes proteinuria, which finally leads a decline in kidney function.[12]

After conducting a multivariate analysis that also took into account the results of the fat and urine analysis, it was discovered that the clinical factors smoking class, blood pressure class, body mass index class, and metabolic syndrome had a significant relationship with the incidence of decreased kidney function from the clinical risk factor group. However, the clinical factors alcohol class, sports class, GDP class,

fat analysis, and urine analysis did not.

Bivariate analysis revealed that there was a significant link between impaired kidney function and the occupational risk factor group of manufacturing-type risk factors, with a 2.8 times chance of it happening compared to other forms of manufacturing. This may be due to the prevalence of food and beverage manufacturers in the inclusion data pool.

There is a strong association between decreasing kidney function and the risk factors for length of work, according to the findings of bivariate analysis, but no further research been found that can shed light on the causes. Given that this research is global and does not concentrate on a specific manufacturing type, it is necessary to conduct additional research on occupational and prospective risks in the manufacturing industry.

The results of bivariate analysis on the risk factor for non-ergonomic body position showed a significant relationship with a decrease in kidney function, but with a smaller chance for workers who work non-ergonomically compared to workers who work ergonomically; this is different from Suryani and Yulius (2015) who suggested that working in an unergonomic position can increase the risk of stress in workers,[13] which then increases the risk of kidney function. This may be due to the significant difference in the proportion of workers who reported being exposed to uncomfortable positions compared to those who reported not being exposed to uncomfortable positions. Additionally, since this statement is only subjective, additional ergonomic testing and evaluation are required.

Based on bivariate analysis, it was discovered that the risk factors for hot and cold temperatures, workloads that did not match the time and amount of work, prolonged sitting for more than 4 hours continuously, and workloads that did not match the time and amount of work were not significantly related to the incidence of decreased kidney function. While the type of manufacture, length of work, and non-ergonomic body position are occupational factors that have a significant relationship, it was discovered through multivariate analysis that only the length of work factor had an impact on the incidence of decreased kidney function, and that the type of manufacture and non-ergonomic body position were considered confounding factors.

According to the findings of this study, occupational risk factors were linked to a decline in kidney function in manufacturing workers, with the duration of service over 19 years being the most significant predictor. among light of this, the research hypothesis that occupational risk variables affect the likelihood of impaired kidney function among workers in the manufacturing business is supported.

In accordance with the findings of other studies, it was discovered from the results of this study that gender, age over 40, hypertension, and obesity have an impact on causing a decrease in kidney function. However, for a length of service of more than 19 years, additional analysis is still required by looking at the factors of specific risks that may be linked to decreased renal function at work.

In particular, if you look at the analysis of occupational risk factors by integrating the knowledge from the results of bivariate analysis (has a significant relationship between manufacturing type, length of work, and non-ergonomic positions), especially ergonomics and multivariate factors (length of work), then in the manufacturing industry, especially food producers and beverages, we can make a comprehensive wellness program, in which ergonomic measures are used. The results of this ergonomic measurement will determine how far the intervention is to be made to improve workplace ergonomics whenever possible. In addition, programs are also carried out to address employee stress, both physically and psychologically. Finally, to foresee the final impact, a program of screening, evaluation, and treatment, can also be carried out, for workers who already have issues with elevated blood pressure.

The programs, which might take the shape of employees getting together or enjoying entertainment to relieve both physical and psychological stress, can vary depending on the company's competence and policy. Thus, screening programs can take the form of arriving and outgoing crew change health surveillance, appraisal from the company's doctor, and treatment program as suggested for anticipating on the final impact (hypertension).

The abundance of data in this study and the high caliber of the examination performed by one of the best occupational health and safety service providers in Indonesia contribute to its strength, which makes it more likely that the conclusions drawn from the data analysis will be accurate and offer suggestions for action. Due to the use of secondary data, this study has a disadvantage in that it may not be able to provide the researcher with the exact information they are looking for or be able to address their specific research questions.

Additionally, because the data used in this study are secondary data, the researcher is unable to influence the operational definitions that are used because respondents rely on their own (subjective) perceptions and are not accompanied by clear operational definitions.

Conclusion

In this study, it was discovered that 33.8% of all manufacturing industry workers in West Java who performed MCU in 2022 had decreased kidney function (Glomerular Filtration Rate / GFR <90 ml/minute/1.73m^2). Workers in the manufacturing sector may develop chronic kidney disease as a result of this ailment.

The characteristics of individual risk factors, clinical risk factors, and occupational risk factors are related and will have an important impact on decreasing kidney function in West Java manufacturing industry workers in 2022. Male gender, age more than 40, first and second grade hypertension, obesity, and length of employment greater than 19 years have all been proven to be risk factors for impaired kidney function in employees. The male gender is the main determining factor.

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